Digitized by the Internet Archive
in 2013

http://archive.org/details/generaltechnical5660nort

by Stanford L. Arner
and Donald W. Seegrist

"MISSING"
A Computer Program for the Maximum Likelihood Estimates of the Parameters of the Multivariate Linear Model with Incomplete Measurements

GOVT. DOCUMENTS
DEPOSITORY ITEM

APR 11 1980

CLEMSON
LIBRARY

CLEMSON UNIVERSITY LIBRARY
APR 14 1980
SCI., TECH. & AGR. DIV.

FOREST SERVICE GENERAL TECHNICAL REPORT NE-56
1980
FOREST SERVICE, U.S. DEPARTMENT OF AGRICULTURE
NORTHEASTERN FOREST EXPERIMENT STATION
370 REED ROAD, BROOMALL, PA 19008

Abstract

This report describes a computer program that obtains maximum likelihood estimates of the parameters of a multivariate linear model in which all variates may not be measured on each experimental unit. The variates can be: (1) repeated measurements on the same characteristic, (2) different characteristics, or (3) a mixture of repeated measurements and different characteristics.

MANUSCRIPT RECEIVED FOR PUBLICATION 29 OCTOBER 1979

The Authors

STANFORD L. ARNER joined the Northeastern Forest Experiment Station in 1966 and has served as a computer programmer and biological statistician with the Station's Biometrics Group, located in Broomall, Pa. He received a B.S. degree in forest science in 1966 from the Pennsylvania State University, and a M.S. degree in 1971 from the School of Forest Resources at Pennsylvania State University.

DONALD W. SEEGRIST joined the Northeastern Forest Experiment Station in 1968 and currently is Leader of the Station's Biometrics group. He received a B.S. degree in zoology in 1963 from George Washington University, and M.S. and Ph.D. degrees in zoology in 1959 and 1965, respectively, from the University of California, Berkeley. He joined the Forest Service in 1963 as a biological statistician with the Pacific Southwest Forest and Range Experiment Station at Berkeley.

INTRODUCTION

THIS TECHNICAL REPORT describes a computer program that obtains maximum likelihood estimates of the parameters of a multivariate linear model with correlated errors when some of the dependent variates are not measured on some of the experimental units.

Our procedure was developed to model the forest growth and yield functions when there are more than two repeated measurements per plot, but not all measurements are made on every plot. The program was developed to obtain solutions to this model, but can also be used to solve several well-known statistical models including the multivariate linear regression model (Anderson 1958), and Zellner's (1962) seemingly unrelated regressions model.

DEFINITIONS AND NOTATIONS USED IN INCOMPLETE MULTIVARIATE MODELS

Suppose we have a study with N plots on which T variates $Y_1 \ldots, Y_t, \ldots Y_T$ can be measured, but not all variates are measured on each plot. The missing measurements may be missing by design or by chance. The N plots can be divided into K disjoint groups $G_1 \ldots, G_k, \ldots G_K$. The k^{th} group consists of the N_k plots on which a subset of T_k of the variates are measured. The variates can be: (1) repeated measurements on the same characteristic, (2) different characteristics, or (3) a mixture of repeated measurements and different characteristics.

As an example, suppose that three variates Y_1, Y_2, and Y_3 are measured. The seven groups that are possible are

Group	G_1	G_2	G_3	G_4	G_5	G_6	G_7
Variates	1	2	3	1,2	1,3	2,3	1,2,3

Groups 1 through 6 are incompletely measured; Group 7 has a complete set of measurements.

Let y_{kti} be the observed value of the variate Y_t on the i^{th} plot in the k^{th} group. The $N_k \times 1$ vector of observations on Y_t in the k^{th} group is defined by:

$$y_{kt} = (y_{kt1} \ldots y_{ktN_k})'.$$

The $N_k T_k \times 1$ composite vector of observed values of variates measured in the k^{th} group is defined by $y_k = (\ldots y'_{kt} \ldots)'$. To illustrate, the overall vector of observations for group 5 is $y_5 = (y'_{51}, y'_{53})'$.

The model for the incomplete composite response vector is written in terms of group vectors and group design matrices as

$$\begin{bmatrix} y_1 \\ \cdot \\ \cdot \\ \cdot \\ y_k \\ \cdot \\ \cdot \\ \cdot \\ y_K \end{bmatrix} = \begin{bmatrix} X_1 \\ \cdot \\ \cdot \\ \cdot \\ X_k \\ \cdot \\ \cdot \\ \cdot \\ X_K \end{bmatrix} \beta + \begin{bmatrix} \epsilon_1 \\ \cdot \\ \cdot \\ \cdot \\ \epsilon_k \\ \cdot \\ \cdot \\ \cdot \\ \epsilon_K \end{bmatrix}$$

where

$$y'_k = (y'_{k1}, \ldots, y'_{kt}, \ldots, y'_{kT})$$

$$X'_k = (X'_{k1}, \ldots, X'_{kt}, \ldots, X'_{kT})$$

and

$$y'_{kt} = [y_{kt1}, \ldots, y_{ktN_k}]$$

$$X'_{kt} = [x'_{kt1}, \ldots, x'_{ktN_k}]$$

$$x_{kti} = [x_{kti1}, \ldots, x_{ktiq}].$$

β is a composite vector of model parameters of length q and ϵ_k is the $T_k N_k \times 1$ vector of random errors associated with y_k.

We assume that the observations on the T_k variates on each plot of group k have a common covariance matrix V_k, while the observations on the N_k plots are mutually independent. Under these assumptions, the covariance matrix for y_k can be written $V_k \otimes I_k$ where $\otimes$ denotes the Kronecker product and I_k is an identity matrix of order N_k.

It is also assumed that response vectors from different groups $(y_k, y_{k'}, k \neq k')$ are mutually independent. Therefore, the covariance matrix of the composite response vector $y = (y'_1, \ldots, y'_K)'$ is

$$\Psi = \begin{bmatrix} (V_1 \otimes I_1) & \ldots & 0 \\ \cdot & \ldots & \cdot \\ 0 & \ldots & (V_K \otimes I_K) \end{bmatrix}$$

V_k is a function of the population covariance V, which is the $T \times T$ covariance matrix that would exist among the complete set of T variates.

The form of the design matrix $X = (X'_1, \ldots X'_k, \ldots X'_K)'$ and the vector of parameters, β, depends on the specific model and the variates measured. To illustrate the notation, we show the observational structure for three specific models assuming the three-variate situation introduced previously.

For Sullivan and Clutter's (1972) yield model, the variates are repeated measurements on a plot. The observational equations for the complete group with three measurements are

$$\begin{bmatrix} y_{71} \\ y_{72} \\ y_{73} \end{bmatrix} = \begin{bmatrix} X_{71} \\ X_{72} \\ X_{73} \end{bmatrix} \beta$$

whereas the observational structure for group 5, where only variates 1 and 3 are measured, is

$$\begin{bmatrix} y_{51} \\ y_{53} \end{bmatrix} = \begin{bmatrix} X_{51} \\ X_{53} \end{bmatrix} \beta$$

If N_k plots are measured at time t, y_{kt} is a column vector of length N_k, and X_{kt} is $N_{kt} \times q$. The $q \times 1$ vector of parameters, β, is the same for all measurement periods. The observed values of the independent variables in X_{kt} change over time.

The observational equations for the complete group in a multivariate linear regression model can be written

$$\begin{bmatrix} y_{71} \\ y_{72} \\ y_{73} \end{bmatrix} = \begin{bmatrix} X_{71} \\ X_{72} \\ X_{73} \end{bmatrix} \beta = \begin{bmatrix} X^*_7 & 0 & 0 \\ 0 & X^*_7 & 0 \\ 0 & 0 & X^*_7 \end{bmatrix} \begin{bmatrix} \beta_1 \\ \beta_2 \\ \beta_3 \end{bmatrix}$$

The observational equations for group 5 are

$$\begin{bmatrix} y_{51} \\ y_{53} \end{bmatrix} = \begin{bmatrix} X_{51} \\ X_{53} \end{bmatrix} \beta = \begin{bmatrix} X^*_5 & 0 & 0 \\ 0 & 0 & X^*_5 \end{bmatrix} \begin{bmatrix} \beta_1 \\ \beta_2 \\ \beta_3 \end{bmatrix}$$

Notice that: (1) the design matrix X_{kt} is an $N_k \times q$ matrix composed of the $N_k \times q_t$ submatrix X^*_k and null matrices 0, and that (2) $q_t = q_{t'}$. The matrix X_{kt} differs from $X_{kt'}$ by the position of the submatrix X^*_k. The vector of parameters, β_t, differs for each variate.

In the third model, both the design matrices, X_{kt}, and the vectors of parameters, β_t, are different for each variate. The observational equations for the complete group of seemingly unrelated regressions (Zellner 1962) are

$$\begin{bmatrix} y_{71} \\ y_{72} \\ y_{73} \end{bmatrix} = \begin{bmatrix} X^*_{71} & 0 & 0 \\ 0 & X^*_{72} & 0 \\ 0 & 0 & X^*_{73} \end{bmatrix} \begin{bmatrix} \beta_1 \\ \beta_2 \\ \beta_3 \end{bmatrix}$$

The equations for the incomplete group are

$$\begin{bmatrix} y_{51} \\ y_{53} \end{bmatrix} = \begin{bmatrix} X^*_{51} & 0 & 0 \\ 0 & 0 & X^*_{53} \end{bmatrix} \begin{bmatrix} \beta_1 \\ \beta_2 \\ \beta_3 \end{bmatrix}$$

The covariance matrix for a group depends on the variates measured in that group. For example, since group 7 is complete, the covariance matrix of the observations on an experimental unit is V. Group 5 has measurements on variates 1 and 3 only. Therefore, the covariance matrix for observations on an experimental unit in group 5 is

$$V_5 = \begin{bmatrix} \sigma_{11} & \sigma_{13} \\ \sigma_{31} & \sigma_{33} \end{bmatrix}$$

Because of the assumed dependence of the measurements, ordinary least squares (OLS) would not yield efficient estimates of β. We assume that the vector y has a multivariate normal distribution with $\mathcal{E}(y) = X\beta$ and covariance matrix Ψ, and find values of β and V that simultaneously maximize the likelihood function

$$L = (2\pi)^{-\sum_{k=1}^{K} N_k T_k/2} \, |\Psi|^{-1/2} \, e^{-1/2 Q}$$

where

$$Q = \sum_{k=1}^{K} (y_k - X_k \beta)' \, \Psi^{-1}{}_k \, (y_k - X_k \beta)$$

and $\Psi_k = V_k \otimes I_k$.

The symbol $|\Psi|$ denotes the determinant of the matrix Ψ.

The logarithm of the likelihood function is:

$$\ln L = -\tfrac{1}{2}\ln(2\pi)\sum_{k=1}^{K} N_k T_k + \tfrac{1}{2}\sum_{k=1}^{K} N_k \ln V^{-1}{}_k - \tfrac{1}{2}Q.$$

The likelihood equations are the derivatives of lnL taken with respect to β and the elements of V. The maximum likelihood estimators of β and V are those values for which the likelihood equations are simultaneously equal to zero. The expressions for the likelihood equations will be included in a forthcoming publication by Seegrist and Arner.

CALCULATING THE MAXIMUM LIKELIHOOD ESTIMATES

The likelihood equations are nonlinear, and iterative procedures must be used to obtain a solution. We begin with the OLS estimator $\hat{\beta}_o = (X'X)^{-1} X'Y$, and then calculate the sample variances and covariances for each group:

$$\hat{\sigma}_{ktuo} = (y_{kt} - X_{kt}\hat{\beta}_o)'(y_{ku} - X_{ku}\hat{\beta}_o)/N_k .$$

The initial estimates for the elements of V that we use are the average variances and covariances

$$\hat{\sigma}_{tuo} = \Sigma N_k \hat{\sigma}_{ktuo}/\Sigma N_k .$$

These estimates of the variances and covariances are stored in a $[T(T+1)/2 \times 1]$ vector denoted by σ. Denote the overall vector of parameters by $\theta = (\beta', \sigma')'$.

We have several procedures for estimating the vector of regression coefficients and the variances and covariances. The estimate of θ at iteration i is $\hat{\theta}_i = \hat{\theta}_{i-1} - Q^{-1}{}_{i-1} S_{i-1}$. S_{i-1} denotes the vector of first derivatives of lnL — with respect to β and with respect to the elements of Σ — evaluated at $\hat{\theta}_{i-1}$. Q_{i-1} depends on which procedure is used. For the Newton-Raphson procedure, Q_{i-1} is the matrix of second derivatives evaluated at $\hat{\theta}_{i-1}$. For the Fisher scoring procedure, Q_{i-1} is the expected value of the matrix of second derivatives evaluated at $\hat{\theta}_{i-1}$. The formulas for the first and second derivatives can be found in Seegrist and Arner's forthcoming publication.

There are two reasons for having different iterative procedures in the same program. One reason is that there are differences in the rates of convergence. Close to the solution, the Newton-Raphson procedure converges faster than the Fisher scoring procedure. If the estimates are away from the solution, the scoring procedure usually converges faster. The second reason is that the matrix of second derivatives, which is used in the Newton-Raphson procedure, may not be negative definite and its inverse cannot be determined. However, it may be that the estimate of V has an inverse, in which case, Q_{i-1} for the Fisher scoring procedure can be inverted and new estimates of θ can be calculated.

Following the suggestion of Jennrich and Sampson (1976), the Fisher scoring procedure is used for the first iteration and for any iteration for which the change in lnL at the preceding iteration is greater than a specified value. Also, the program switches to the Fisher scoring procedure if the Newton-Raphson procedure does not work.

At any iteration, new estimates for θ may result in a negative change in lnL. Let $\Delta_i = Q^{-1}{}_{i-1} S_{i-1}$ be the vector of increments to θ_{i-1} at iteration i. When Q_{i-1} is negative definite, an increase in lnL can be obtained with a sufficiently small portion of Δ_i, which we determine using a partial stepping procedure similar to that suggested by Jennrich and Sampson (1976). At each step, Δ_i is divided by 4 and new estimates of θ are calculated. The partial stepping is terminated when the value of $\ln L_i$ is more than the value of $\ln L_{i-1}$.

The iterations are terminated when $\ln L_i - \ln L_{i-1} < \epsilon$ where ϵ is a small predetermined value.

PROGRAM INFORMATION

The instructions for input cards are found in Appendix I. The Appendix explains the array sizes and instructions for changing the array sizes for problems that exceed the programed dimensions. The appendix also explains the error messages that are printed if a matrix cannot be inverted.

The program output includes iteration number, solution procedure used, and values of lnL, Q, β, and V. At the final iteration, the program prints R which is the coveriance matrix in correlation form, and prints $S(\hat{\beta})$ which is the sample covariance matrix of the estimated regression coefficients. The estimates of β and V are punched every 10 iterations and after the final iteration. The punched cards can be read as starting values for further iterations, if necessary.

Using the diagonal elements of $S(\hat{\beta})$ as the sample variance of the elements of $\hat{\beta}$, confidence intervals for the individual elements can be calculated.

Likelihood ratio tests can be used to test hypotheses about β for the composite vector of correlated variates. Tests of the type that a portion of the parameter vector is zero are obtained by running the program twice. The first run is with all of the independent variables. The second run is with the independent variables associated with the hypothesized zero portion of β dropped from the vector of independent variables.

If L_Ω is the value of the likelihood function under the full model with q_Ω independent variables and L_ω is the value of the likelihood function under the model restricted by the hypothesis which has q_ω independent variables, then $-2 \ln\lambda = -2 (\ln L_\omega - \ln L_\Omega)$ is distributed asymptotically as χ^2 with $q_\Omega - q_\omega$ degrees of freedom.

Other hypotheses can be tested with appropriate coding of the design matrix.

SAMPLE PROBLEMS

To demonstrate the program, we present two examples. The first example is based on Clutter's (1972) growth and yield model with incomplete repeated measurements on permanent plots. The second example has incomplete measurements because one of the characteristics can only be measured by destructive sampling.

We write Clutter's growth and yield model as

$$\mathcal{E}(\ln V_{ti} \mid \ln B_{ti}) = \beta_0 + \beta_1 S_i + \beta_2 A^{-1}_{ti} + \beta_3 \ln B_{ti}$$

$$\mathcal{E}(\ln B_{ti}) = A_{1i} A^{-1}_{ti} \ln B_{1i} + \alpha_1 (1 - A_{1i} A^{-1}_{ti}) + \alpha_2 (1 - A_{1i} A^{-1}_{ti}) S_i$$

where

V_{ti} = cubic foot volume per acre on the i^{th} plot at time t,

S_i = site index of i^{th} plot (in feet),

A_{ti} = stand age of i^{th} plot at time t,

and

B_{ti} = basal area per acre of the i^{th} plot at time t (in square feet).

We assume that $\ln V_{ti}$ and $\ln B_{ti}$ have a joint normal distribution. Therefore, the marginal distribution of $\ln B_{ti}$ and the conditional distribution of $\ln V_{ti}$ given $\ln B_{ti}$ are independent. The solution to the volume equation and basal area equation could be obtained separately, or they can be obtained in one pass by assigning the observations in the volume model and the observations in the basal area model to two different groups. Further grouping of the data occurs because measurements on some of the plots are incomplete. Of the 51 plots measured, 15 plots were measured 3 times; 16 plots were measured in the first and second period; the remaining 20 plots were measured in the first and third periods.

To obtain a solution to the volume and basal area equations in one pass, one instructs the program that there are six groups.

The data cards for the six groups have the following general form:

<table>
<tr><th><i>Variate Number</i></th><th>y</th><th>x_1</th><th>x_2</th><th>x_3</th><th>x_4</th><th>x_5</th><th>x_6</th></tr>
<tr><td colspan="8">The data cards for plots in <i>GROUP 1</i> have the form</td></tr>
<tr><td>1</td><td>$\ln V_1$</td><td>1</td><td>S</td><td>A^{-1}_1</td><td>$\ln B_1$</td><td>0</td><td>0</td></tr>
<tr><td>2</td><td>$\ln V_2$</td><td>1</td><td>S</td><td>A^{-1}_2</td><td>$\ln B_2$</td><td>0</td><td>0</td></tr>
<tr><td>3</td><td>$\ln V_3$</td><td>1</td><td>S</td><td>A^{-1}_3</td><td>$\ln B_3$</td><td>0</td><td>0</td></tr>
<tr><td colspan="8">The data cards for plots in <i>GROUP 2</i> have the form</td></tr>
<tr><td>4</td><td>$\ln B^*_2$</td><td>0</td><td>0</td><td>0</td><td>0</td><td>$1-A_1 A^{-1}_2$</td><td>$(1-A_1 A^{-1}_2)S$</td></tr>
<tr><td>5</td><td>$\ln B^*_3$</td><td>0</td><td>0</td><td>0</td><td>0</td><td>$1-A_1 A^{-1}_3$</td><td>$(1-A_1 A^{-1}_3)S$</td></tr>
<tr><td colspan="8">The data cards for plots in <i>GROUP 3</i> have the form</td></tr>
<tr><td>1</td><td>$\ln V_1$</td><td>1</td><td>S</td><td>A^{-1}_1</td><td>$\ln B_1$</td><td>0</td><td>0</td></tr>
<tr><td>2</td><td>$\ln V_2$</td><td>1</td><td>S</td><td>A^{-1}_2</td><td>$\ln B_2$</td><td>0</td><td>0</td></tr>
<tr><td colspan="8">The data cards for plots in <i>GROUP 4</i> have the form</td></tr>
<tr><td>4</td><td>$\ln B^*_2$</td><td>0</td><td>0</td><td>0</td><td>0</td><td>$1-A_1 A^{-1}_2$</td><td>$(1-A_1 A^{-1}_2)S$</td></tr>
<tr><td colspan="8">The data cards for plots in <i>GROUP 5</i> have the form</td></tr>
<tr><td>1</td><td>$\ln V_1$</td><td>1</td><td>S</td><td>A^{-1}_1</td><td>$\ln B_1$</td><td>0</td><td>0</td></tr>
<tr><td>3</td><td>$\ln V_3$</td><td>1</td><td>S</td><td>A^{-1}_3</td><td>$\ln B_3$</td><td>0</td><td>0</td></tr>
<tr><td colspan="8">The data cards for plots in <i>GROUP 6</i> have the form</td></tr>
<tr><td>5</td><td>$\ln B^*_3$</td><td>0</td><td>0</td><td></td><td>0</td><td>$1-A_1 A^{-1}_3$</td><td>$(1-A_1 A^{-1}_3)S$</td></tr>
</table>

where $\ln B^*_t$ is $\ln B_t - A_1 A^{-1}_t \ln B_1$.

The input cards for this example are as follows:

Control Card 1 — General Title Card

Field (1) — Title

Control Card 2 — Job Control Card

Field (1) — Blank DELT = 1.0 x 10^{-10}
Field (2) — Blank SNR = .001
Field (3) — 5 = number of variates
Field (4) — 6 = number of independent variables
Field (5) — 6 = number of groups
Field (6) — 40 = maximum number of iterations
Field (7) — 0 = results printed on last iteration only
Field (8) — 5 = data is located on file 5
Field (9) — 1 = number of variable format cards
Field (10) — 0 = no intercept in model
Field (11) — 0 = no unobserved pairs of variates
Field (12) — 0 = initial estimates to be calculated from data
Field (13) — 11 = number of comment cards to read and print

Control Card 3 — Group Variate Card

Field (1) — 3 = number of variates in group 1
Field (2) — 2 = number of variates in group 2
Field (3) — 2 = number of variates in group 3
Field (4) — 1 = number of variates in group 4
Field (5) — 2 = number of variates in group 5
Field (6) — 1 = number of variates in group 6

Control Card 4 — Group Sample Size Card

Field (1) — 16 = number of plots in group 1
Field (2) — 16 = number of plots in group 2
Field (3) — 15 = number of plots in group 3
Field (4) — 15 = number of plots in group 4
Field (5) — 20 = number of plots in group 5
Field (6) — 20 = number of plots in group 6

11 *Comment Cards*

Variable Format Card

185 *Data Cards*

The printed output consists of the information on the general title card, the job control values, the comment cards, and the variable format for the data.

This is followed by values of the initial estimates which are $\ln L_o$, Q_o, the vector $\hat{\beta}_o$, and the matrix $\hat{\Sigma}_o$.

The initial estimates are followed by the maximum likelihood estimates from the last iteration. The values of lnL and Q are given. This is followed by the maximum likelihood estimates $\hat{\beta}$, $\hat{\Sigma}$, and $\hat{R}$, and the sample covariance matrix of $\hat{\beta}$, $S(\hat{\beta})$.

For example, the maximum likelihood estimates are

Parameters	*Estimates* ($\hat{\beta}$)	*Variance* ($s^2(\hat{\beta})$)
β_0	3.2924	0.0016
β_1	0.0117	0.1224 x 10^{-6}
β_2	-26.3890	0.4292
β_3	0.9665	0.3613 x 10^{-4}
α_1	4.0136	0.9978
α_2	0.0314	0.2225 x 10^{-3}

where $s^2(\hat{\beta})$ are the elements on the diagonal of the matrix $S(\hat{\beta})$ at iteration 13.

In the second example, we analyze an incomplete set of measurements which might occur in forestry. Suppose we have an experiment where two levels of fertilizer are applied to a sample of n tree seedlings. The first year height (H_1) is measured on all seedlings, and dry weight (W_1) is measured on m of the seedlings. The remaining seedlings are grown for one more year and height and dry weight are measured.

The experimental design is a one-way layout with incomplete multivariate measurements.

Altogether, four variates are measured; but because dry weight is a destructive measurement, it is not possible to observe the variate pairs (W_1, W_2) and (W_1, H_2). For convenience, we denote the v^th dependent variate measured on a seedling in the k^th group as Y_{kv}. The two variates in group 1 are $Y_{11} = H_1$ and $Y_{13} = W_1$. Similarly, the three variates measured on the seedlings in group 2 are $Y_{21} = H_1$, $Y_{22} = H_2$, and $Y_{24} = W_2$.

The model for the one-way layout can be written as

$$y_{kvij} = \mu_v + \tau_{vi} + \epsilon_{kvij};$$

where

y_{kvij} = the observed value of variate Y_v measured on the j^th seedling in the k^th group treated with the i^th fertilizer level,

and

ϵ_{kvij} = error of variate Y_v measured on j^th seedling in k^th group treated with the i^th fertilizer level.

Let μ_{vi} = the mean of the i^th treatment for the v^th variable;

then

$$\mu_v = (\mu_{v1} + \mu_{v2})/2$$

and

$$\tau_{vi} = \mu_{vi} - \mu_v.$$

Observational equations describing the two measurements on the j^th seedling in group 1 receiving fertilizer level i are

$$\begin{bmatrix} h_{1ij} \\ w_{1ij} \end{bmatrix} = \begin{bmatrix} 1 & \delta_{ij} & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & \delta_{ij} & 0 & 0 \end{bmatrix} \beta$$

where δ_{ij} is the dummy variable for the treatment effect and is

$$\delta_{ij} = 1 \text{ for } i = 1$$

$$= -1 \text{ for } i = 2$$

and the vector of regression coefficients β is

$$[\mu_1 \;\; \tau_1 \;\; \mu_2 \;\; \tau_2 \;\; \mu_3 \;\; \tau_3 \;\; \mu_4 \;\; \tau_4]'.$$

Similarly, the three observational equations for the j^th seedling in group 2 receiving treatment i would be

$$\begin{bmatrix} h_{1ij} \\ h_{2ij} \\ w_{2ij} \end{bmatrix} = \begin{bmatrix} 1 & \delta_{ij} & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & \delta_{ij} & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & \delta_{ij} \end{bmatrix} \beta.$$

Using the fictitious data given in Appendix II, we obtained the following estimates:

Variate	*Parameter*	*Estimate* $(\hat{\beta})$	*Variance* $(s^2(\hat{\beta}))$
H_1	μ_1	4.925	.0681
	τ_1	-0.475	.0681
H_2	μ_2	9.419	.1088
	τ_2	-0.922	.1088
W_1	μ_3	37.705	2.3103
	τ_3	-4.885	2.3103
W_2	μ_4	44.511	3.8375
	τ_4	-6.369	3.8375

To test the composite hypothesis of "no treatment effect," we need the value of the logarithm of the likelihood function which is $\ln L = -97.7$.

The hypothesis of "no treatment effect" for any of the responses is $\tau_i = 0$ for $i = 1, \ldots, 4$. The design matrix for the model under the hypothesis is obtained from the design matrix for the full model by dropping the four treatment dummy variables.

The value of lnL calculated when the restricted model was run was -104.2. The test statistic -2(-104.2 + 97.7) = 13.0 would be statistically significant ($\chi^2_{.05,4} = 9.47$).

The sample correlation matrix is printed out as

Variate	H_1	H_2	W_1	W_2
H_1	1.0			
H_2	0.79	1.0		
W_1	0.83	0.0	1.0	
W_2	0.68	.80	0.0	1.0

Notice that the correlations $r(W_1, W_2)$ and $r(W_1, H_2)$, are shown as having values 0.0. However, $r(W_1, W_2)$ and $r(W_1, H_2)$ are not estimable in this example.

This program can be used to obtain a solution when the measurements on all experimental units are complete. However, for the complete measurement situation, a computationally more efficient procedure is presented in Arner and Seegrist (1979). In fact, if only a portion of the data are complete, it may be better to use the first program on the complete subset to obtain estimates of β and Σ to use as initial estimates for the incomplete program.

The program was written in Fortran for an IBM 370/168. A deck and listing of the computer program described in this publication is available on request with the understanding that the U.S. Department of Agriculture cannot assure accuracy, completeness, reliability, or suitability for any other purpose than that reported. The recipient may not assert any proprietary rights thereto nor represent it to anyone as other than a Government-produced computer program. For cost information write U.S. Forest Service, 370 Reed Road, Broomall, Pa. 19008.

LITERATURE CITED

Anderson, T.W.
1958. An introduction to multivariate analysis. Wiley, New York. 374p.

Arner, S.L., and D.W. Seegrist.
1979. A computer program for the maximum likelihood estimator of the general multivariate linear model with correlated errors. USDA For. Serv. Gen. Tech. Rep. NE-51. 10p.

Clutter, J.L.
1963. Compatible growth and yield model for loblolly pine. For. Sci. 9(3) 355-371.

Jennrich, R.I., and P.F. Sampson.
1976. Newton-Raphson and related algorithms for maximum likelihood variance component estimation. Technometrics 18(1):11-17.

Sullivan, A.D., and J.L. Clutter.
1972. A simultaneous growth and yield model for loblolly pine. For. Sci. 18:76-86.

Zellner, A.
1962. An efficient method of estimating seemingly unrelated regressions and tests for aggregation bias. JASA 57(298):348-368.

APPENDIX I

```
C *********************************************************************
C *** CONTROL CARDS
C   1. TITLE CARD   -   FORMAT = (10A8)
C   2. JOB CONTROL CARD
C      COLS.  1-10 DELT = END ITERATIONS VALUE. DEFAULT = 1.E-10, WHEN
C                         THE PROPORTIONATE CHANGE OF THE LOG LIKELIHOOD
C                         FUNCTION IS LESS THAN DELT, ITERATIONS STOP.
C            11-20 SNR  = NEWTON-RAPHSON, FISHER SCORING CUTOFF POINT.
C                         DEFAULT = .001, WHEN PROPORTIONATE CHANGE IN
C                         THE LOG LIKELIHOOD FUNCTION IS LESS THAN *SNR*
C                         THE NEWTON RAPHSON PROCEDURE IS USED;
C                         IF GREATER, THE FISHER PROCEDURE IS USED.
C                         NOTE: BOTH DELT AND SNR ARE READ WITH F10.3
C                         FORMAT.
C            21-22 P    = LENGTH OF Y. THE NO. OF DEPENDENT VARIATES,
C                         INCLUDING REPEATED MEASUREMENTS. NOT ALL P
C                         VARIATES NEED TO BE MEASURED ON EACH
C                         EXPERIMENTAL UNIT.
C            23-24 Q    = LENGTH OF X. THE NO. OF INDEPENDENT VARIABLES,
C                         THE INDEPENDENT VARIABLES CAN BE THE SAME OR
C                         DIFFERENT FOR EACH DEPENDENT VARIATE. WHERE
C                         AN INDEPENDENT VARIABLE IS NOT MEASURED FOR A
C                         PARTICULAR Y, A ZERO SHOULD BE CODED FOR THAT
C                         X.
C            25-26 NG   = NO. OF GROUPS. A GROUP IS DEFINED AS THE SET
C                         OF EXPERIMENTAL UNITS, EACH OF WHICH CONTAINS
C                         THE SAME SUBSET OF DEPENDENT VARIATES.
C            27-28 NITR = MAXIMUM NO. OF ITERATIONS (DEFAULT = 30).
C            29-30 IPR  = PRINT OPTION.    IF IPR = ....
C                       = 0 PRINT RESULTS AT LAST ITERATION ONLY.
C                       = 1 PRINT LOG LIKELIHOOD FUNCTION, DIFFERENCE,
C                           AND VALUE OF QUADRATIC FORM EACH ITERATION.
C                       = 2 PRINT ABOVE PLUS ESTIMATES OF BETA AND SIGMA
C                           EACH ITERATION.
C            31-32 DF   = FILE ON WHICH DATA IS LOCATED (DEFAULT = 5).
C                         IF THE DATA  ARE NOT ON  CARDS, THE FILE ON
C                         WHICH THE DATA RESIDES MUST BE DEFINED WITH
C                         APPROPRIATE JOB CONTROL LANGUAGE.
C            33-34 NF   = NO. OF FORMAT CARDS (MAX. = 5, DEFAULT = 1).
C            35-36 INT  = INTERCEPT INDICATOR; IF INT NOT EQUAL 0, Q IS
C                         INCREASED BY 1 AND A COLUMN OF 1'S IS ADDED
C                         TO THE X MATRIX.
C            37-38 MIS  = NO. OF PAIRS OF VARIATES NEVER OBSERVED
C                         TOGETHER ON THE SAME EXPERIMENTAL UNIT; IF Y1
C                         AND Y2 ARE NEVER OBSERVED TOGETHER, NO
C                         COVARIANCE BETWEEN THE TWO CAN BE CALCULATED.
C                         THE PROGRAM CAN DETERMINE THIS VALUE. HOWEVER
C                         IF IT IS KNOWN AND READ HERE, THE SIZE OF
C                         CERTAIN ARRAYS CAN BE REDUCED (SEE ARRAY SIZE
C                         DEFINITIONS BELOW).
C            39-40 INP  = INITIAL ESTIMATE INDICATOR;  IF INP = ...
C                       = 0 INITIAL ESTIMATES OF BETA AND SIGMA ARE
C                           CALCULATED FROM DATA.
C                       = 1 READ INITIAL VALUES FOR BETA AND SIGMA.
C                           (CARD TYPE 6 AND 7) MAY BE FROM PREVIOUS
C                           RUN.
C            41-42 NC   = NO. OF ADDITIONAL COMMENTS CARDS(CARD 5)
```

```
C   3. (NP(G),G=1,NG) , THE NO. OF DEPENDENT VARIATES FOR EACH GROUP
C                       FORMAT = (40I2).
C   4. (NPLT(G),G=1,NG),THE NO. OF EXPERIMENTAL UNITS (PLOTS) FOR EACH
C                       GROUP,   FORMAT = (16I5)
C   5. COMMENTS CARDS - OPTIONAL; READ ONLY IF *NC* ON CARD 2 IS > 0
C                       FORMAT = (10A8) -VARIABLE NAMES CAN BE READ HERE
C ***  READ CARD TYPES 6 AND 7 ONLY IF INP = 1,  FORMAT = (5D16.8).
C   6. INITIAL ESTIMATES OF BETA.
C   7. INITIAL ESTIMATES OF SIGMA.
C   8. FORMAT OF DATA  ( INCLUDING 1 INTEGER AS THE FIRST ITEM FOLLOWED
C         BY   Q+1  REAL FORMAT CODES)
C   9. DATA - THE DATA SHOULD BE CODED AS FOLLOWS:
C        A. THE FIRST POSITION OF EACH RECORD SHOULD HAVE AN INTEGER
C           VALUE SPECIFYING THE DEPENDENT VARIATE FOR THIS RECORD.
C,          THIS WILL BE A VALUE FROM  1 TO P.
C        B. THE DEPENDENT VARIATE SHOULD BE CODED NEXT.
C        C. THE Q INDEPENDENT VARIABLES FOLLOW THE DEPENDENT VARIATE.
C           THERE ARE Q POSITIONS FOR THE INDEPENDENT VARIABLES. NOT ALL
C           INDEPENDENT VARIABLES NEED TO BE OBSERVED WITH EACH
C           DEPENDENT VARIATE; A  0  SHOULD BE CODED IN THE APPROPRIATE
C           POSITION.
C        D. ALL CORRELATED OBSERVATIONS FOR AN EXPERIMENTAL UNIT (PLOT)
C           SHOULD BE CONTIGUOUS.
C        E. THE EXPERIMENTAL UNITS FOR EACH GROUP SHOULD BE CONTIGUOUS.
C **********************************************************************
C *** EXAMPLE OF JCL FOR DEFINING DATA ON DISK WHERE DF=8 IN COLUMN 32
C     OF CONTROL CARD 2:
C     //GO.FT08F001 DD UNIT=3330,VOL=SER=UE1014,DSN=YIELD,DISP=SHR
C **********************************************************************

C **********************************************************************
C *** INSTRUCTIONS FOR CHANGING ARRAY DIMENSIONS. REQUIRED ONLY IN MAIN
C     ROUTINE.
C     1. DETERMINE NG,Q,P, AND NP(G),G=1,NG.
C     2. WITH THESE VALUES CALCULATE QQ,PP,QPPI,PPS,PSQS,PPI,PQP,PPP
C        USING ARRAY SIZE DEFINITIONS BELOW.
C     3. CHANGE DIMENSION SIZE OF ARRAYS TO APPROPRIATE VALUES,
C     4. CHANG MXQ TO Q, MXXP TO P, MXQPPI TO QPPI, MXPPS TO PPS,
C        MXPSQS TO PSQS, MXPP TO PP, MXPPI TO PPI, MXNG TO NG,
C        MXNF TO NF.
C **********************************************************************
C **********************************************************************
C *** ARRAY SIZE DEFINITIONS
C     QQ  = Q*(Q+1)/2                                       MAX = MXQQ
C     PP  = P*(P+1)/2                                       MAX = MXPP
C     PPI = PP-MIS   MIS IS DEFINED ON  JOB CONTROL CARD.   MAX = MXPPI
C     QPPI= Q+PPI                                           MAX = MXQPPI
C     PPP = PPI*(PPI+1)/2
C     PQP = QPPI*(QPPI+1)/2                                 MAX = MXPQP
C     PPS = THE SUM OVER ALL GROUPS OF (NP(G)*(NP(G)+1)/2)  MAX = MXPPS
C     PSQS= THE SUM OVER ALL GROUPS OF (NP(G)*NP(G))
C *** ARRAY DIMENSIONS MUST BE AT LEAST THE SIZE BELOW.
C     REAL*8 SIGMA(PP),YPY(PPS),PLSS(PPP),Y(P),SIGINV(PPS),PLS(PPI),
C            DERIV1(QPPI),XPY(PSQS,Q),XPX(PPS,Q,Q),DELTA(QPPI),X(P,Q),
C            XPY2(Q),XPXB(Q),BETA(Q),PLBB(QQ),PLB(Q),
C            PLBS(PPI,Q),DERIV2(PQP)
C     INTEGER TP(NG,P),NP(NG),NPLT(NG),PTYPY(NG),PTXPY(NG),DROP(PP)
C **********************************************************************
C **********************************************************************
C     THERE ARE 5 PLACES WHERE FATAL MATRIX INVERSIONS MIGHT OCCUR. A
C     MESSAGE IS PRINTED WITH A NUMBER INDICATING WHERE THE INVERSION
C     FAILED.
C     1 = X'X
C     2 = INITIAL SIGMA OR PORTION OF SIGMA
C     3 = MATRIX OF EXPECTED VALUES OF SECOND DERIVATIVES WITH RESPECT
C         TO SIGMA.
C     4 = MATRIX OF SECOND DERIVATIVES WITH RESPECT TO BETA.
C     5 = GROUP PORTION OF NEW ESTIMATE OF SIGMA.
C **********************************************************************
```

APPENDIX II

```
SAMPLE PROBLEM 1, GROWTH AND YIELD USING CLUTTER'S EQUATIONS, 6 GROUPS
                        5 6 640 0 5 1 0 0 011
 3 2 2 1 2 1
   16    16    15    15    20    20
*****************************************************************************
VARIABLE NAMES
   Y1 = LN(VOL) AT TIME 1;  Y2 = LN(VOL) AT TIME 2;
   Y3 = LN(VOL) AT TIME 3;  Y4 = (LN(BA2) - LN(BA1)*AGE1/AGE2);
   Y5 = (LN(BA3) - LN(BA1)*AGE1/AGE3);  X1 = INTERCEPT; X2 = SITE INDEX;
   X3 = 1/(PLOT AGE); X4 = LN(BA(T)); X5 = (1-A(1)/A(T)); X6 = X5 * SI;
***   Y1,Y2,Y3 = F(X1,X2,X3,X4);   Y4,Y5 = F(X5,X6)   ***

  G  P  V     Y         X1   X2      X3          X4          X5          X6

*****************************************************************************
(6X,I3,F10.5,2F5.1,4F10.5)
  1  1  1    7.92039  1.0 68.0    0.02041    4.50443    0.0         0.0
  1  1  2    8.02682  1.0 68.0    0.01818    4.56226    0.0         0.0
  1  1  3    8.14199  1.0 68.0    0.01695    4.62475    0.0         0.0
  1  2  1    7.69006  1.0 72.0    0.02273    4.29007    0.0         0.0
  1  2  2    7.88382  1.0 72.0    0.02000    4.42700    0.0         0.0
  1  2  3    8.04967  1.0 72.0    0.01852    4.53828    0.0         0.0
                                  .
                                  .
                                  .
  2  1  4    0.54923  0.0  0.0    0.0        0.0        0.10909    7.41818
  2  1  5    0.88376  0.0  0.0    0.0        0.0        0.16949   11.52542
  2  2  4    0.65174  0.0  0.0    0.0        0.0        0.12000    8.64000
  2  2  5    1.04267  0.0  0.0    0.0        0.0        0.18519   13.33333
                                  .
                                  .
                                  .
  3  1  1    6.69724  1.0 61.0    0.02500    3.45526    0.0         0.0
  3  1  2    7.03527  1.0 61.0    0.02174    3.72569    0.0         0.0
  3  2  1    7.65128  1.0 75.0    0.02000    4.19750    0.0         0.0
  3  2  2    7.79770  1.0 75.0    0.01887    4.28110    0.0         0.0
                                  .
                                  .
                                  .
  4  1  4    0.72112  0.0  0.0    0.0        0.0        0.13043    7.95652
  4  2  4    0.32119  0.0  0.0    0.0        0.0        0.05660    4.24528
                                  .
                                  .
                                  .
  5  1  1    7.54987  1.0 74.0    0.03125    4.26637    0.0         0.0
  5  1  3    7.78030  1.0 74.0    0.02564    4.41502    0.0         0.0
  5  2  1    7.10497  1.0 77.0    0.03030    3.81777    0.0         0.0
  5  2  3    7.69454  1.0 77.0    0.02500    4.28827    0.0         0.0
                                  .
                                  .
                                  .
  6  1  5    0.91441  0.0  0.0    0.0        0.0        0.17949   13.23205
  6  2  5    1.13861  0.0  0.0    0.0        0.0        0.17500   13.47500
```

```
SAMPLE PROBLEM 1, GROWTH AND YIELD USING CLUTTER'S EQUATIONS, 6 GROUPS

PROGRAM CONTROL INFORMATION
******************************
P  (NO.  OF VARIATES, INCLUDING DIFFERENT VARIABLES AND REPEATED MEASUREMENTS) =     5
Q  (NO. OF INDEPENDENT VARIABLES) =                                                  6
NG  (NO. OF GROUPS) =                                                                6
NITR  (MAXIMUM NO. OF ITERATIONS) =                                                 40
IPR  (PRINT OPTION) =                                                                0
DF  (FILE ON WHICH DATA IS LOCATED) =                                                5
NF  (NO.OF FORMAT CARDS) =                                                           1
INP  (INITIAL VALUES INDICATOR) =                                                    0
MIS  (NO. OF MISSING VARIATE COMBINATIONS) =                                         0
INT  (INTERCEPT INDICATOR) =                                                         0
DELT  (END ITERATIONS VALUE) =                                                  0.100E-09
SNR  (NEWTON RAPHSON - FISHER SCORING   CUTOFF POINT) =                         0.100E-02

NO. OF VARIATES (P) AND EXPERIMENTAL UNITS OR PLOTS (N) MEASURED IN EACH GROUP
*********************************************************************************
GROUP     1    2    3    4    5    6
P(G)      3    2    2    1    2    1
N(G)     16   16   15   15   20   20

ADDITIONAL PROBLEM OR VARIABLE IDENTIFICATION
************************************************************************
************************************************************************
VARIABLE NAMES
    Y1 = LN(VOL) AT TIME 1;  Y2 = LN(VOL) AT TIME 2;
    Y3 = LN(VOL) AT TIME 3;  Y4 = (LN(BA2) - LN(BA1)*AGE1/AGE2);
    Y5 = (LN(BA3) - LN(BA1)*AGE1/AGE3);  X1 = INTERCEPT; X2 = SITE INDEX;
    X3 = 1/(PLOT AGE); X4 = LN(BA(T)); X5 = (1-A(1)/A(T)); X6 = X5 * SI;
***   Y1,Y2,Y3 = F(X1,X2,X3,X4);   Y4,Y5 = F(X5,X6)   ***

  G  P  V    Y       X1   X2     X3        X4        X5        X6

************************************************************************

FORMAT OF DATA
***************
(6X,I3,F10.5,2F5.1,4F10.5)

INITIAL VALUES
***************

LOG OF THE LIKLIHOOD FUNCTION =    220.78277
************************************************

THE VALUE OF THE QUADRATIC FORM =     492.19537
***************************************************

INITIAL ESTIMATE OF REGRESSION COEFFICIENTS  (BETA)
*****************************************************
  0.33769660D+01  0.10295165D-01 -0.26387855D+02  0.97374591D+00  0.46237813D+01
  0.17473433D-01
INITIAL ESTIMATE OF SIGMA
*************************

  1   0.8929532D-03
  2   0.1200484D-03   0.1436344D-03
  3   0.2100115D-03   0.4459130D-04   0.7336672D-03
  4   0.0             0.0             0.0             0.2737580D-02
  5   0.0             0.0             0.0             0.7424596D-03   0.4865128D-02
```

```
ITERATION  =    13     CRITERION USED AT THIS STEP = NEWTON RAPHSON
*************************************************************************

LOG OF THE LIKLIHOOD FUNCTION =     318.09751          DIFFERENCE =    .66631856D-09
*******************************************************************************************
PROPORTIONATE DIFFERENCE =     .20946985E-11

VALUE OF THE QUADRATIC FORM =      185.00000
**************************************************

NO. OF QUARTERING STEPS USED =     0
****************************************

REGRESSION COEFFICIENTS  (BETA)
**********************************
   0.32924017D+01  0.11682717D-01 -0.26388781D+02  0.96652491D+00  0.40136489D+01  0.31400960D-01

ESTIMATE OF COVARIANCE MATRIX  (SIGMA)
*****************************************
   1   0.19484190D-02
   2   0.46803600D-03   0.22831480D-03
   3   0.15533210D-02   0.74079890D-03   0.35864010D-02
   4   0.0              0.0              0.0              0.12541680D-01
   5   0.0              0.0              0.0              0.12929080D-01   0.14226530D-01

CORRELATIONS
**************
   1   0.10000000D+01
   2   0.70173170D+00   0.10000000D+01
   3   0.58761180D+00   0.81866060D+00   0.10000000D+01
   4   0.0              0.0              0.0              0.10000000D+01
   5   0.0              0.0              0.0              0.96792190D+00   0.10000000D+01

SAMPLE COVARIANCE MATRIX OF ESTIMATED REGRESSION COEFFICIENTS
*************************************************************************
   1   0.15790950D-02
   2  -0.83163860D-05   0.12240100D-06
   3  -0.14642300D-01  -0.45973600D-06   0.42919240D+00
   4  -0.17541830D-03   0.18563740D-07   0.13821620D-02   0.36135970D-04
   5   0.0              0.0              0.0              0.0              0.99776310D+00
   6   0.0              0.0              0.0              0.0             -0.14836520D-01   0.22249410D-03
```

```
SAMPLE PROBLEM 2, FULL MODEL MANOVA,  2 GROUPS, 2 TREATMENTS
                     4 8 220 0 5 1 0 0 010
 2 3
   10   10
**************************************************************************
VARIABLE NAMES
  V  = VARIATE NUMBER
  Y1 = HEIGHT INCREASE FOR FIRST YEAR
  Y2 = HEIGHT INCREASE FOR SECOND YEAR
  Y3 = DRY WEIGHT FOR FIRST YEAR
  Y4 = DRY WEIGHT FOR SECOND YEAR
  X = X1=X2=X3=X4 = DUMMY VARIABLES FOR INTERCEPT AND TREATMENTS
 V      Y      X1     X2     X3     X4
**************************************************************************
(I2,F7.1,3X,4(2F2.0,2X))
 1    4.8    1 1    0 0    0 0    0 0      GROUP 1, TREATMENT 1
 3   31.0    0 0    0 0    1 1    0 0
 1    4.6    1 1    0 0    0 0    0 0
 3   41.0    0 0    0 0    1 1    0 0
 1    5.8    1 1    0 0    0 0    0 0
 3   35.0    0 0    0 0    1 1    0 0
 1    4.3    1 1    0 0    0 0    0 0
 3   33.0    0 0    0 0    1 1    0 0
 1    3.9    1 1    0 0    0 0    0 0
 3   29.0    0 0    0 0    1 1    0 0
 1    4.9    1-1    0 0    0 0    0 0      GROUP 1, TREATMENT 2
 3   37.0    0 0    0 0    1-1    0 0
 1    5.3    1-1    0 0    0 0    0 0
 3   42.0    0 0    0 0    1-1    0 0
 1    4.7    1-1    0 0    0 0    0 0
 3   40.0    0 0    0 0    1-1    0 0
 1    3.9    1-1    0 0    0 0    0 0
 3   36.0    0 0    0 0    1-1    0 0
 1    6.1    1-1    0 0    0 0    0 0
 3   49.0    0 0    0 0    1-1    0 0
 1    4.5    1 1    0 0    0 0    0 0      GROUP 2, TREATMENT 1
 2    8.9    0 0    1 1    0 0    0 0
 4   33.0    0 0    0 0    0 0    1 1
 1    3.2    1 1    0 0    0 0    0 0
 2    8.7    0 0    1 1    0 0    0 0
 4   41.0    0 0    0 0    0 0    1 1
 1    4.3    1 1    0 0    0 0    0 0
 2    9.0    0 0    1 1    0 0    0 0
 4   37.0    0 0    0 0    0 0    1 1
 1    2.4    1 1    0 0    0 0    0 0
 2    5.1    0 0    1 1    0 0    0 0
 4   22.0    0 0    0 0    0 0    1 1
 1    6.7    1 1    0 0    0 0    0 0
 2    9.8    0 0    1 1    0 0    0 0
 4   53.0    0 0    0 0    0 0    1 1
 1    8.1    1-1    0 0    0 0    0 0      GROUP 2, TREATMENT 2
 2   12.2    0 0    1-1    0 0    0 0
 4   55.0    0 0    0 0    0 0    1-1
 1    4.8    1-1    0 0    0 0    0 0
 2    9.6    0 0    1-1    0 0    0 0
 4   48.0    0 0    0 0    0 0    1-1
 1    5.2    1-1    0 0    0 0    0 0
 2   10.1    0 0    1-1    0 0    0 0
 4   49.0    0 0    0 0    0 0    1-1
 1    4.3    1-1    0 0    0 0    0 0
 2    9.5    0 0    1-1    0 0    0 0
 4   51.0    0 0    0 0    0 0    1-1
 1    6.7    1-1    0 0    0 0    0 0
 2   12.1    0 0    1-1    0 0    0 0
 4   60.0    0 0    0 0    0 0    1-1
SAMPLE PROBLEM 2, REDUCED MODEL,  2 GROUPS, 2 TREATMENTS
                     4 4 220 0 8 1 0 0 0 0
 2 3
   10   10
(I2,F7.1,3X,4(F2.0,4X))
```

```
SAMPLE PROBLEM 2, FULL MODEL MANOVA,  2 GROUPS, 2 TREATMENTS

PROGRAM CONTROL INFORMATION
*********************************
P  (NO.  OF VARIATES, INCLUDING DIFFERENT VARIABLES AND REPEATED MEASUREMENTS) =        4
Q  (NO. OF INDEPENDENT VARIABLES) =                                                     8
NG  (NO. OF GROUPS) =                                                                   2
NITR  (MAXIMUM NO. OF ITERATIONS) =                                                    20
IPR  (PRINT OPTION) =                                                                   0
DF  (FILE ON WHICH DATA IS LOCATED) =                                                   5
NF  (NO.OF FORMAT CARDS) =                                                              1
INP  (INITIAL VALUES INDICATOR) =                                                       0
MIS  (NO. OF MISSING VARIATE COMBINATIONS) =                                            0
INT  (INTERCEPT INDICATOR) =                                                            0
DELT  (END ITERATIONS VALUE) =                                                  0.100E-09
SNR  (NEWTON RAPHSON - FISHER SCORING   CUTOFF POINT) =                        0.100E-02

NO. OF VARIATES (P) AND EXPERIMENTAL UNITS OR PLOTS (N) MEASURED IN EACH GROUP
*****************************************************************************
GROUP     1     2
P(G)      2     3
N(G)     10    10

ADDITIONAL PROBLEM OR VARIABLE IDENTIFICATION
**********************************************************************
**********************************************************************
VARIABLE NAMES
  V   = VARIATE NUMBER
  Y1 = HEIGHT INCREASE FOR FIRST YEAR
  Y2 = HEIGHT INCREASE FOR SECOND YEAR
  Y3 = DRY WEIGHT FOR FIRST YEAR
  Y4 = DRY WEIGHT FOR SECOND YEAR
  X = X1=X2=X3=X4 = DUMMY VARIABLES FOR INTERCEPT AND TREATMENTS
 V      Y       X1      X2      X3      X4
**********************************************************************

FORMAT OF DATA
***************
(I2,F7.1,3X,4(2F2.0,2X))

INITIAL VALUES
***************

LOG OF THE LIKLIHOOD FUNCTION =    -104.19460
**************************************************

THE VALUE OF THE QUADRATIC FORM =       73.817068
*****************************************************

INITIAL ESTIMATE OF REGRESSION COEFFICIENTS  (BETA)
*******************************************************
  0.49250000D+01 -0.47500000D+00  0.95000000D+01 -0.12000000D+01  0.37300000D+02

  -0.35000000D+01   0.44900000D+02   -0.77000000D+01

INITIAL ESTIMATE OF SIGMA
*************************

  1   0.13612500D+01
  2   0.86650000D+00   0.10360000D+01
  3   0.98800000D+00   0.0              0.95800000D+01
  4   0.41560000D+01   0.47150000D+01   0.0              0.30530000D+02
```

```
ITERATION  =    10     CRITERION USED AT THIS STEP = NEWTON RAPHSON
******************************************************************

LOG OF THE LIKLIHOOD FUNCTION =    -97.668625         DIFFERENCE =     .14210855D-13
*************************************************************************************
PROPORTIONATE DIFFERENCE = .14550071E-15
VALUE OF THE QUADRATIC FORM =     50.000001
**********************************************

NO. OF QUARTERING STEPS USED =     2
**********************************

REGRESSION COEFFICIENTS  (BETA)
******************************
   0.49250000D+01 -0.47500000D+00  0.94188830D+01 -0.92249458D+00  0.37704918D+02
  -0.48852460D+01   0.44510938D+02   -0.63689988D+01
ESTIMATE OF COVARIANCE MATRIX  (SIGMA)
*************************************
  1    0.1361250D+01
  2    0.1162321D+01   0.1584718D+01
  3    0.5802049D+01   0.0             0.3546775D+02
  4    0.5574847D+01   0.7092847D+01   0.0             0.4979030D+02

CORRELATIONS
*************
  1    0.1000000D+01
  2    0.7913726D+00   0.1000000D+01
  3    0.8350176D+00   0.0             0.1000000D+01
  4    0.6771606D+00   0.7984950D+00   0.0             0.1000000D+01

SAMPLE COVARIANCE MATRIX OF ESTIMATED REGRESSION COEFFICIENTS
***************************************************************
  1    0.6806250D-01
  2    0.0             0.6806250D-01
  3    0.5811604D-01   0.0             0.1088487D+00
  4    0.0             0.5811604D-01   0.0             0.1088487D+00
  5    0.2901025D+00   0.0             0.2477077D+00   0.0             0.2310273D+01
  6    0.0             0.2901025D+00   0.0             0.2477077D+00   0.0
  7    0.2787424D+00   0.0             0.4712770D+00   0.0             0.1188082D+01
  8    0.0             0.2787424D+00   0.0             0.4712770D+00   0.0


                                       0.2310273D+01
                                       0.0             0.3837471D+01
                                       0.1188081D+01   0.0             0.3837471D+01
```

```
SAMPLE PROBLEM 2, REDUCED MODEL,  2 GROUPS, 2 TREATMENTS

PROGRAM CONTROL INFORMATION
******************************
P  (NO.  OF VARIATES, INCLUDING DIFFERENT VARIABLES AND REPEATED MEASUREMENTS) =      4
Q  (NO. OF INDEPENDENT VARIABLES) =                                                   4
NG  (NO. OF GROUPS) =                                                                 2
NITR  (MAXIMUM NO. OF ITERATIONS) =                                                  20
IPR  (PRINT OPTION) =                                                                 0
DF  (FILE ON WHICH DATA IS LOCATED) =                                                 8
NF  (NO.OF FORMAT CARDS) =                                                            1
INP  (INITIAL VALUES INDICATOR) =                                                     0
MIS  (NO. OF MISSING VARIATE COMBINATIONS) =                                          0
INT  (INTERCEPT INDICATOR) =                                                          0
DELT  (END ITERATIONS VALUE) =                                                0.100E-09
SNR  (NEWTON RAPHSON - FISHER SCORING   CUTOFF POINT) =                       0.100E-02

NO. OF VARIATES (P) AND EXPERIMENTAL UNITS OR PLOTS (N) MEASURED IN EACH GROUP
*********************************************************************************
GROUP     1     2
P(G)      2     3
N(G)     10    10

FORMAT OF DATA
***************
(I2,F7.1,3X,4(F2.0,4X))

INITIAL VALUES
***************

LOG OF THE LIKLIHOOD FUNCTION =    -109.85307
************************************************

THE VALUE OF THE QUADRATIC FORM =      73.049606
***************************************************

INITIAL ESTIMATE OF REGRESSION COEFFICIENTS  (BETA)
*****************************************************
  0.4925000D+01  0.5500000D+01  0.3730000D+02  0.4490000D+02


INITIAL ESTIMATE OF SIGMA
*************************

  1   0.1586875D+01
  2   0.1346500D+01   0.1756000D+01
  3   0.1250500D+01   0.0              0.1570500D+02
  4   0.7236000D+01   0.9335000D+01   0.0              0.6014500D+02
```

```
ITERATION  =    10     CRITERION USED AT THIS STEP = NEWTON RAPHSON
**********************************************************************

LOG OF THE LIKLIHOOD FUNCTION =   -104.24262          DIFFERENCE =    .11723955D-12
****************************************************************************************
PROPORTIONATE DIFFERENCE - .11246795E-14
VALUE OF THE QUADRATIC FORM =     50.000000
************************************************

NO. OF QUARTERING STEPS USED =    0
************************************

REGRESSION COEFFICIENTS  (BETA)
********************************
  0.4925000D+01  0.9404167D+01  0.3773877D+02  0.4385001D+02

ESTIMATE OF COVARIANCE MATRIX  (SIGMA)
***************************************
  1   0.1586875D+01
  2   0.1600785D+01   0.2410211D+01
  3   0.8164522D+01   0.0             0.6054900D+02
  4   0.8602508D+01   0.1274906D+02   0.0             0.8847127D+02

CORRELATIONS
*************
  1   0.1000000D+01
  2   0.8185289D+00   0.1000000D+01
  3   0.8329251D+00   0.0             0.1000000D+01
  4   0.7260267D+00   0.8730709D+00   0.0             0.1000000D+01

SAMPLE COVARIANCE MATRIX OF ESTIMATED REGRESSION COEFFICIENTS
******************************************************************
  1   0.7934375D-01
  2   0.8003923D-01   0.1602803D+00
  3   0.4082261D+00   0.4118044D+00   0.3954564D+01
  4   0.4301254D+00   0.8410104D+00   0.2213009D+01   0.6515401D+01
```

Headquarters of the Northeastern Forest Experiment Station are in Broomall, Pa. Field laboratories and research units are maintained at:

- Amherst, Massachusetts, in cooperation with the University of Massachusetts.
- Beltsville, Maryland.
- Berea, Kentucky, in cooperation with Berea College.
- Burlington, Vermont, in cooperation with the University of Vermont.
- Delaware, Ohio.
- Durham, New Hampshire, in cooperation with the University of New Hampshire.
- Hamden, Connecticut, in cooperation with Yale University.
- Kingston, Pennsylvania.
- Morgantown, West Virginia, in cooperation with West Virginia University, Morgantown.
- Orono, Maine, in cooperation with the University of Maine, Orono.
- Parsons, West Virginia.
- Princeton, West Virginia.
- Syracuse, New York, in cooperation with the State University of New York College of Environmental Sciences and Forestry at Syracuse University, Syracuse.
- University Park, Pennsylvania, in cooperation with the Pennsylvania State University.
- Warren, Pennsylvania.

GOVT. DOCUMENTS
DEPOSITORY ITEM

APR 29 1980

CLEMSON
LIBRARY

PROCEEDINGS

1980 National Outdoor Recreation Trends Symposium

Volume I

U.S. Department of Agriculture, Forest Service
Northeastern Forest Experiment Station
370 Reed Road, Broomall, PA 19008

ponsored by:

ortheast Agricultural
xperiment Stations, NE-100

SDA Forest Service

SDI Heritage Conservation
d Recreation Service

creation Working Group,
ciety of American Foresters

iversity of New Hampshire,
creation and Parks Program

cooperation with:

emson University

urnal of Leisure Research

rdue University

CLEMSON UNIVERSITY LIBRARY
MAY 1 1980
SCI., TECH. & AGR. DIV.

USDA, Forest Service General Technical Report NE—57

FOREWORD

Most of us would probably endorse a one-year moratorium on meetings, conferences, conventions, workshops, and symposia. In fact, this planning committee was so reluctant to assemble another conference that it spent nearly 2 years identifying the needs and developing the program. When the rate of change is as great as it has been in outdoor recreation, conferences such as this one become essential. This is an exceptional conference because it focuses on that change, documents it, and attempts to determine what its future implications may be.

Ten years ago, a Forest Recreation Symposium was held at Syracuse, N.Y., for the purpose of "consolidating and synthesizing past research efforts in outdoor recreation." Even a hasty comparison of these proceedings with those from Syracuse suggests the enormous volume of research that has occurred over these 10 years. Equally apparent is the change in the kinds of research information that are available today; from the static descriptive and prescriptive studies of the late 1960's to examinations of trends, shifts, and changes in the outdoor recreation economy. Effective planning requires this dynamic view of outdoor recreation. Because planning, whether for corporate investment or public development, is a long-range activity, it needs information that goes beyond simple statements of "what is" into the realm of "what has been" and "what will be."

Statistical reporting is a critical function of government. Without this essential service, it would be difficult, if not impossible, to assess the state of the economy, the quality of health care, or the adequacy of public education. Price indexes, business slumps, new construction, pollution levels, production facts, and employment figures pop out of Washington bureaus onto boardroom conference tables with almost biologic regularity. Agriculture, mining, housing, manufacturing, wholesale and retail trade, doctors, dentists, educators, butchers, bakers, and even high school guidance counselors have more federally-sponsored statistics to plan with than do the providers of America's outdoor recreation opportunities. We attempt to plan the future of the Nation's recreation resources in the absence of facts about the present level and rate of growth of private investment in leisure industries. We define policy on the basis of out-of-date data and ideas about public participation in recreation activities. And, we invest scarce research dollars in "problems" which may not exist, or might at least look different if we had adequate statistics with which to view them. This symposium will not correct the situation. It can only serve to heighten your present uneasiness over the quantity and quality of available trend data. But we hope it will instill an urgency within you to demand better, more current, and more comprehensive statistics on outdoor recreation in America.

Good planning has been described as a two-step process. "First you figure out what is inevitable. Then you find a way to take advantage of it." In assembling this collection of speakers and topics, we have provided you with the best available information on, if not the inevitable, at least that which is highly probable and highly improbable. Step 2 -- how you take advantage of that information --is what recreation researchers will be monitoring in the years ahead.

WILBUR F. LaPAGE, Chairman
Program Committee

American Demographics, September 1979.
Used by permission.

THE 1980 NATIONAL
OUTDOOR RECREATION TRENDS SYMPOSIUM

Held at the New England Center for Continuing Education
University of New Hampshire
Durham, New Hampshire
April 20-23, 1980

SPONSORED BY

Northeast Agricultural Experiment Stations, Project NE-100

USDA Forest Service, Northeastern Forest Experiment Station

USDI, Heritage Conservation and Recreation Service

Society of American Foresters, Recreation Working Group

University of New Hampshire, Recreation and Parks Program

PROGRAM COMMITTEE --

Wilbur F. LaPage
Malcolm I. Bevins
Robert D. Greenleaf
Floyd L. Newby
Gerald L. Cole
A. Robert Koch
Herbert E. Echelberger
Douglas M. Knudson

CONCURRENT SESSIONS --

Floyd L. Newby
Herbert E. Echelberger
Douglas M. Knudson
Kenneth J. Hock
Marvin W. Kottke
Mahmood Seyala

ADVISORS --

R. Duane Lloyd
Earl Patric
Basil J. F. Mott
Roland Robinson
Meg Maguire
Robert McLellan
Barry Tindall
Hugo John
Fred Knight

LOCAL ARRANGEMENTS --

Robert D. Greenleaf
Herbert E. Echelberger
Gus C. Zaso
Lawrence A. Rondeau
Patricia C. Merrill

COOPERATORS

Clemson University, Department of Recreation and Park Administration

Journal of Leisure Research, NRPA

Purdue University, Department of Forestry and Natural Resources

CONTENTS

DATA-DEFICIENT PLANNING: AN OVERVIEW

Social indicators and outdoor recreation: the forgotten sector

John D. Peine, Robert W. Marans, and Charles C. Harris 1

The role of futures forecasts in recreation: some applications in the third nationwide outdoor recreation plan

Meg Maguire and Dana R. Younger 19

Trend indicators needed for effective recreation planning--a statistical blueprint for the 80's

H. Fred Kaiser, and George H. Moeller ...27

TRENDS IN THE LEISURE ECONOMY

The growth of selected leisure industries

Elizabeth R. Owen 33

Trends in financing and availability of capital

Donald G. Schink 41

Trends in private and commercial recreation

Arlin Epperson 47

FACILITATING TRENDS

Travel Trends and energy

Thomas M. Corsi and Milton E. Harvey 59

Trends in state outdoor recreation from periodic to process planning: the Minnesota example

William H. Becker and George W. Orning ..71

Trends in land and water available for outdoor recreation

Lloyd C. Irland and Thomas Rumpf 77

TRENDS IN POLICY AND INFLUENCE

Trends in outdoor recreation legislation

George H. Siehl (Vol. II)

Trends in organizational memberships and lobbying

William R. Burch 89

Trends in public policies and programs

Gerald Purvis and Darrell Lewis (Vol. II)

TRENDS IN RECREATION ACTIVITIES/MARKETS

Skiing trends

Charles R. Goeldner and Stacy Standley..105

Hunting and fishing trends in the U.S.

J. John Charbonneau and James R. Lyons..121

Off-road vehicle trends

Garrell E. Nicholes....................127

National boating trends

Albert J. Marmo 135

Trends in river recreation

Earl C. Leatherberry, David W. Lime and Jerrilyn LaVarre Thompson 147

Camping and RV travel trends

Gerald L. Cole and Wilbur F. LaPage 165

Trends in the market for privately owned seasonal recreational housing

Richard L. Ragatz......................179

Trends in hiking and backcountry use

Edward L. Spencer, Herbert E. Echelberger, Raymond E. Leonard and Craig Evans 195

Trends in emerging and high risk activities

Robert G. White, Richard Schreyer, and Kent Downing 199

Trends in day uses of parks and forests

Joseph T. O'Leary, John Peine, and Dale Blahna 205

Trends in outdoor recreation activity conflicts

John J. Lindsay 215

TREND MEASUREMENT PROBLEMS

Trends or methodological differences?

Daniel J. Stynes, Malcolm I. Bevins, and Tommy L. Brown 223

The trend of measuring public use of the national parks

Kenneth E. Hornback 233

Data banks for recreation supply and participation

E. M. Avedon and S. L. J. Smith 243

SOCIAL INDICATORS AND OUTDOOR RECREATION:
THE FORGOTTEN SECTOR[1]

John D. Peine
Robert W. Marans
Charles C. Harris[2]

Abstract.--Following a brief historical overview of the social indicators movement, outdoor recreation measures which can be considered as social indicators are discussed. Such indicators are largely derived from social surveys. Illustrative data from 53 such surveys are presented. Despite the availability of such data, there have been few attempts to adapt them as established indicators in the outdoor recreation field. Reasons for not considering the data as indicators are suggested. Finally, a number of parameters which might be used as social indicators in outdoor recreation in the 1980's are outlined.

WHAT ARE SOCIAL INDICATORS?

Although policy makers and planners are familiar with the concept of "social indicators," there is little consensus among them as to what constitutes a social indicator and how indicators are intended to be used. The ambiguity associated with the concept in part reflects the evolutionary nature of what has been referred to for more than a decade as a movement. The social indicators movement, however is not that new. In the late 1920's, President Hoover appointed a commission to report on the changing social conditions taking place in the United States. The results of that commission's efforts were published in 1933 and described social trends reflecting various aspects of life in the United States. In addition to the report, 13 separate monographs were produced, covering topics ranging from nutrition and health to recreation and leisure.

The movement, however, received its label in the mid-1960's with the publication of Raymond Bauer's widely publicized book, Social Indicators. The focus of Bauer's edited volume was on the development and use of social measures in assessing the state of society in relation to national goals. One influential chapter covered social systems accounting and called for the development of comprehensive models describing the structures of entire social systems.

In part as a response to the Bauer publication, the federal government issued Toward A Social Report in the late 1960's. The report, prepared by HEW, detailed the need for social indicators as a way of assessing the progress the country was making toward achieving societal goals. One part of the report focused on the compilation of descriptive statistics in a format such that they could be aggregated for summary purposes or disaggregated to allow for detailed analysis of sub-areas and subpopulations of the country. Another theme considered the collection of direct measures of welfare and the need to contrast them with the more readily available measures of government expenditures or other types of inputs. Implicit in this theme is the notion that measures of welfare should be expressed in terms of outputs and herein lies one of the central issues facing the social indicator movement today; that is, just how do we measure output?

This issue is brought home when reviewing the two government volumes, Social Indicators,

---

[1] Paper presented at the National Outdoor Recreation Trends Symposium, Durham NH, April 20-23, 1980.

[2] John D. Peine is a planner with Heritage Conservation and Recreation Service, U.S. Department of the Interior. Robert W. Marans is a program director at The University of Michigan's Institute for Social Research and a professor in the College of Architecture and Urban Planning, while Charles C. Harris is a graduate student in the University's School of Natural Resources. All are based in Ann Arbor, Michigan.

1973 and Social Indicators, 1976. In the first volume, measures of welfare are expressed in terms of various statistics describing conditions of American life. Measures of longevity, mental retardation, crime, educational attainment and income obtained from various governmental records are typical of the material reported in the volume. It is not difficult to understand why there is a lack of consensus about social indicators when one considers these types of measures. On the one hand, they can be viewed as the direct measures of welfare called for in Toward a Social Report; on the other hand, they might be viewed as inputs by some who would argue that they do not present a complete picture of what is happening in the country.

In Social Indicators, 1976, the descriptive measures are presented once again, but also there is greater attention given to public perceptions of social conditions. In the social indicator movement, the distinction is made between these two types of indicators: one deals with the objective conditions of society while the other covers peoples' responses to these conditions. The distinction between objective and subjective indicators is reflected in much of the quality of life research conducted over the past decade. Some studies describe quality of life in a particular place in terms of its crime rate, its level of unemployment or the amount of air pollution, while others describe quality of life by the way people experience it and as reflected by their attitudes and behaviors. Thus, social indicators can be talked about in terms of social accounting, ways of monitoring social change and reporting social conditions or measuring the quality of life as people experience it.

While there is some agreement that social indicators however described are needed, the question of how indicators are and should be used is far from clear. Ideally, indicators in the form of social statistics could be used to guide decision makers in their deliberations. However, a systematic study of the use of Social Indicators, 1973 by federal bureaucrats shows that few make direct use of such data. (Caplan and Barton 1978)

AVAILABLE OUTDOOR RECREATION INDICATORS

Voluminous data are available on all facets of outdoor recreation. Providers of outdoor recreation opportunity have collected data on facilities, lands, programs and equipment sales. Additionally, information has been solicited from participants in outdoor recreation activities and the general public. Typical data from social surveys have included participation rates, use pattern descriptions, preferences for participation and constraints to participation. This paper focuses primarily on information solicited from such surveys.

By the 1970's, surveys dealing with outdoor recreation had become an integral part of the planning functions for all seven federal land managing agencies and all Statewide Comprehensive Outdoor Recreation Plans. A study of recreation surveys was conducted for the years 1970-77 as part of an unpublished analysis of the 1977 National Ourdoor Recreation Surveys. It revealed that various federal agencies and the majority of state governments, as well as commercial researchers, had conducted 65 major surveys oriented specifically to outdoor recreation. Approximately 650,000 people have participated in these surveys which carry a price tag in excess of 6 million dollars. Dozens more small-scale surveys have also been carried out. In total, these survey efforts have produced a wealth of information on outdoor recreation.

The national outdoor recreation surveys

Research in outdoor recreation came to the forefront early in the 1960's at a time when the concept of social indicators was gaining visibility. The Outdoor Recreation Resource Review commission (ORRRC) produced a series of reports which are, even today, unprecedented in their scope and comprehensiveness. Recreation data were presented on financing, behaviors, attitudes, management, and existing and potential resource supply. Unfortunately, these data have never been fully utilized as bench marks for establishing social trends.

In 1965, while the perspectives of ORRRC were still fresh, the newly formed Bureau of Outdoor Recreation (BOR) sponsored a national recreation survey which was a close approximation of the 1960 survey conducted for the ORRRC. According to its enabling legislation, the BOR was intended to be the federal focal point for recreation research and the collection of trend data. Hopes were high that the generation of social indicators for outdoor recreation was an established fact.

Unfortunately, the 1965 BOR survey never lived up to its research expectations. The data were never fully analyzed and only a small portion of the findings have been published. Data from this and the earlier ORRRC survey were soon lost and with them the opportunity to establish a trend line for outdoor recreation indicators. The 1965 survey experience had established a trend of sorts, in that subsequent national recreation surveys were sponsored by BOR/HCRS in 1970, 1971, 1972, and 1977. (BOR was renamed the Heritage Conservation and Recreation Service in 1977) None of these surveys have been thoroughly analyzed, very little has been published, and until recently, some of the data were unavailable.

An additional problem in establishing trends is that the comparability of those surveys is limited. A methodological summary of the four most comparable surveys sponsored by the BOR/HCRS is shown in Table 1. Participation rates shown in Table 2 illustrate the difficulty in comparing these survey results over time. That difficulty stems from variation in sampling techniques, activity names, length of recall for participation, and the circumstances of the participation (summer only, during type of trip, or year around). The 1972 survey provided an underestimate of activity participation relative to findings of the 1960 and 1965 surveys according to an analysis of the methodology of the first five national outdoor recreation citizen surveys (Stowell 1975). On the other hand, participation in the 1977 survey was an apparent overstatement for several activities in comparison to other contemporary national surveys. This discrepancy was probably due to a shift to data collection by telephone. Thus, although a series of national surveys was envisioned as providing trend data from which social indicators would evolve, it did not happen.

Other federally collected outdoor recreation data

Federal involvement in outdoor recreation research has been considerable. During the search for data comparable to the 1977 National Outdoor Recreation Survey, contact with 16 agencies representing six departments of the federal government uncovered 41 surveys conducted in the previous five years. This momentum for federal recreation surveys continues to build since all seven federal land managing agencies are presently planning or conducting new surveys.

Table 3 displays descriptive comparisons among a sample of federal surveys. Some surveys were conducted on site while others were of regional or national scope. A variety of questions has been asked and many survey techniques were applied. The opportunity to identify common data for several time reference points is limited, but on the other hand many questions have been asked more than once. Federal land managing agencies also have a wealth of descriptive data covering their resource areas. Social indicators on recreation opportunities provided by the federal government could be compiled easily if reporting standards for descriptive inventories were applied. Such standards have recently been adopted for reporting visitation to federal recreation areas (Federal Recreation Fee Program, 1978). The trouble with using federal visitation figures as a social indicator is that it is difficult and expensive to accurately collect them. As a result, reported visitation figures invariably are viewed with considerable skepticism.

State collected outdoor recreation data

The greatest volume of data concerning outdoor recreation behavior has been collected through surveys sponsored by state governments. Statewide surveys have been conducted by 43 states since 1970, including at least one during every year of that decade. These surveys are conducted as part of the Statewide Comprehensive Outdoor Recreation Plans which are required by BOR/HCRS for state participation in the Land and Water Conservation Fund. No attempt has ever been made by BOR/HCRS to encourage standardization of some key elements of these state surveys in order to expedite regional market analysis or suggest national trends. Unfortunately, the utilization of statewide surveys to help establish outdoor recreation trends has never been explored. More opportunity for coordination continues to be lost as 18 state governments are now in the process of planning or conducting new outdoor recreation surveys. Table 4 illustrates descriptive comparisons among 25 statewide outdoor recreation surveys. In every state the primary theme is the establishment of participation rates which are in turn applied to some demand-supply-needs analysis. As is the case with the BOR/HCRS surveys, most of the time spent with the respondents has been devoted to obtaining information for the establishment of participation rates. After all this effort, no consensus exists as to whether these rates are accurate or whether when collected over time, they represent trends. The paradox is having the public sector collect such a formidable mountain of data without being able to describe basic behavioral trends. It is out of this kind of sheer frustration that this conference is being held here today.

The state governments typically maintain extensive inventories of recreation related facilities, lands and programs allowing definitive analyses of geographic distribution and accessibility. On the other hand, the detail of information collected and reporting methods are variable and thereby hinder regional analysis and make national analysis virtually impossible. Encouraging progress in coordinating the collection and analysis of statewide surveys and inventory data has been initiated in the northwestern, northeastern, and southeastern sections of the country (Recreation Data Subcommittee, 1975). If this trend toward consolidation of methodology continues, the potential for utilizing such information to establish trend data is most promising.

Commercially collected outdoor recreation data

Unquestionably, the best trend data in outdoor recreation activity available today is provided by the commercial sector. Descriptions of some commercial sector surveys are presented in Table 5. These surveys are generally restricted to reporting incidents of activity participation. The Neilsen Company has replicated its 1973 outdoor recreation survey twice (Table 6); the resulting trend data are probably the most accurate available.

Similarly, manufacturers of outdoor recreation equipment keep records of unit sales. Such data reflect public interest and involvement in many recreation activities. For example, manufacturers were the first to report that the boom in tennis and bicycling had tapered off and that the boom in snow skiing is still strong.

COMMON LIMITATIONS TO ESTABLISHING INDICATORS

Problems arise in attempting to compare results among surveys which are conducted for different purposes and therefore are not exact replications of each other. For instance, the "universe" or population upon which the surveys are based varies considerably according to each survey's purpose. Some surveys sample a cross section of all people within a geographic boundary such as a park, a state, or a region of the country; others may focus on the population of the entire nation. Additionally, surveys may focus only on certain segments of the population such as those people participating in specific activities such as boating, hunting, camping, or fishing.

Sampling methodologies reflect vastly different study purposes and circumstances of time, money, personnel and expertise. Questionnaires are administered in person, via telephone or by mail. Combinations of techniques such as the handout, mail back format are becoming more common. Rarely are rigorous tests made on the effect specific techniques have on the accuracy of the sample drawn. Sample size also varies ranging from 600 to over 20,000 respondents. Data gathered from most surveys are weighted using various schemes to correct for sampling bias. Often these procedures are complicated and not well documented, making data manipulation potentially more difficult as time passes and as familiarity with the process fades.

Common themes are followed in virtually all outdoor recreation surveys, but it is rare to find questions relating to those themes phrased in the same manner. For example, the number of recreational activity names included in various surveys ranges from 10 to more than 40. What appears as a single activity in one survey may be divided into two, three, or even four activities in another. Definitions of activities also vary among surveys; for instance, is "camping by tent" the same as "primitive camping?"

Another difficulty concerns the variations in time frames used in different surveys to determine from the respondent whether or not participation has taken place. For example: "Have you been camping in the last (seven days, three months, year)?" The longer the recall period, the less likely the response will be accurate.

Data are reported in a variety of formats. Survey reports vary from simple frequency counts on response to the publication of computer printouts of cross tabulations with many statistical tests. Activity participation may be expressed as a simple percentage of the total population, or as specific activity days or participation occasions, all of which may be presented within varying categories of frequency of participation. Tremendous variation also occurs in the way standard socioeconomic factors are categorized. Income, for instance, may be grouped anywhere from three to ten categories.

Limitations associated with comparisons among recreation inventory data sets stem from similar concerns: lack of standard definitions, levels of detail in data description, and fragmented reporting of data.

USES OF EXISTING OUTDOOR RECREATION DATA

Despite the previously stated difficulties in data comparison, there is enormous potential represented by the wealth of unminded data which have been collected.

As the result of the large number of surveys and a large variety of questions asked, most topics of inquiry have been covered in the work. The most obvious example of opportunity for comparative data analysis is activity participation rates. All state and commercial surveys include some type of participation data as do several of the federal surveys. Such a comparative analysis of activity participation rates has recently been published by Dr. Malcolm Bevins of the

University of Vermont who devised trend lines for participation in several activities over time.

Other broad brush trends in outdoor recreation participation can also be portrayed. Trends in the demographic descriptions of recreation participants can be derived showing shifts over time in who is involved in each activity (O'Leary and Peine 1980). Examples of other categories of questions commonly asked are portrayed in Tables 1, 3, and 4. An example of the type of information gleaned from similar questions is portrayed in Table 7 which displays questions on the effect on recreation of gasoline price and availability which have been included in six surveys since the gasoline shortage of 1973.

In order for existing data to be more actively utilized in the policy arena, two conditions must be met. First, the data must be more readily available for analysis and, second, researchers must become more involved in data interpretation for specific policy issues. Significant progress on the accessibility front has been made by the establishment of the National Leisure Archive at the Institute of Social Research, University of Michigan. To date, 30 data sets from questionnaire type surveys on outdoor recreation, sponsored by federal and state agencies, are on file and most new surveys in the planning stages will be entered when the data are available. On the interpretation front, the active use of data from the HCRS national outdoor recreation surveys by researchers at 80 universities around the country constitutes a breakthrough in analysis. It is hoped policy makers will more actively seek out the research community to interpret existing data in terms of specific topical issues on outdoor recreation.

POTENTIAL SOCIAL INDICATORS FOR OUTDOOR RECREATION

Still another, and perhaps the most significant reason indicators for outdoor recreation have not been established in the past is that there is no simple, agreed upon way of measuring the social benefits derived from outdoor recreation. Such benefits from participation, for instance, could stem from personal rewards such as satisfaction from mastering a physical skill, greater physical fitness, relief from stress, a sense of adventure, improved self concept, greater worker productivity, greater family solidarity, change of pace in daily routine, or communing with nature. Obviously, the list could go on.

From this myriad of potential candidates for social parameters in outdoor recreation, which would be the most useful to monitor over time? This difficult question hits at the crux of the dilemma. It is doubtful that social scientists and public policy makers will ever find an answer to such a question through consensus of opinion.

This next section of the paper briefly reviews selected parameters in terms of how extensively data have been gathered on them, how they have been applied to policy formulation, and an opinion as to their future utility in the rapidly changing world of outdoor recreation. This is by no means meant to be an all inclusive listing but rather examples of useful parameters.

Societal changes affecting outdoor recreation include an increase in discretionary time, changing attitudes toward the work ethic and leisure activity, changing family structures, emerging outdoor recreation participation by women and racial minorities, constraints on participants due to high inflation and energy limitations and the growing constraints on public providers of outdoor recreation opportunity.

Indicators we have considerable experience measuring

Considerable data are available for the following outdoor recreation parameters:

Participation rates. As indicated earlier, participation rates are the most commonly collected outdoor recreation parameter and rate comparability among surveys is severely limited by variations in survey methodology, activity names, lengths of recall, unit of measure and context of participation. There is considerable popular interest in participation rates. A commonly asked question is "How many Americans are campers, etc.?" Unfortunately, since participation rates usually are very general in context and their accuracy questionable, their utility in the policy arena is quite limited. Hunting, fishing and camping, for example, are frequently used activity names which are not tied to any particular resource circumstance. Also, participation rates are frequently misinterpreted. Many planners have equated these rates with recreation "demand" in the context of a planning demand-supply-needs analysis. Participation rates are simply a description of consumption which may reflect supply more than public preference. Also, many have attempted to generate predictive "demand" models incorporating resource supply and demographics to predict participation, but the reliability of such models is highly questionable. As a result, participation rates are much more likely to be found in the introductory remarks of outdoor recreation plans than in discussions at meetings on outdoor recreation policy. Measurement of participation rates will most likely endure in the future due to continuing public curiosity about them. Their interpretation may be most useful when tied to socioeconomic factors to show shifts in outdoor recreation interest across age, sex, education, race and income parameters.

Resource availability and utilization. Most recreation studies and plans incorporate inventories of available resources. Federal, state and local land managing agencies maintain resource inventories. Much effort in most outdoor recreation studies is devoted to the compilation of such information. Also, outdoor recreation visitation records at land management units are usually kept. More and more agency managers are expanding the scope of such information to include more specific information on visitor use patterns, preferences and dissatisfactions. The format of such data bases is quite complicated and the list of areas extensive. Also, a variety of units of measurement are applied. As such, the information is not easily translated into definable parameters of resource availability. The usual application of such material is to portray the geographic distribution and diversity of resource opportunity. While it may be doubtful that a universal method of accounting for resource supply will ever be adopted nationally, efforts are being made by federal land managing agencies to develop and adopt a mutually agreed upon system for inventorying and classifying recreation resources. Such systems are needed for state, local and private lands as well. Until these systems are developed, the portrayal of "supply" as a social indicator will continue to be limited to a rather localized perspective.

If the growth of park systems continues to decline as the population becomes more concentrated and travel more restricted, more will have to be learned about the maximum recreational utility of close to home resources. More emphasis will surely be placed here in the 1980's.

Recreational travel. As portrayed in Tables 1, 3, and 4, several recent surveys have included information on travel to participate in recreation activities. Distance traveled, mode of transportation, nature of the trip and expenses incurred have all been repeatedly asked. If national indicators on travel were to evolve, they would most likely be generated by the U.S. Travel Bureau utilizing their repeated recreation travel study. If energy shortages and inflation continue and there persists a dramatic drop in National Park attendance and the sales of recreation vehicles, this parameter may be one of the most important to monitor in the 1980s.

Willingness to pay. Recreation benefits have been estimated by measuring professed willingness to pay for access to particular facilities or areas. Out of pocket expenses to pursue activities have also been monitored in surveys and equated to estimates of the public good. The unit of measure in these instances is the almighty dollar, the most universally accepted measure of public good. The degree to which willingness to pay questions can really predict future behavior is debatable as is the appropriateness of money to represent the multifaceted public good generated from outdoor recreation. However, given today's constraints on public providers of outdoor recreation opportunity, the importance of such information is obvious. Pay as you go recreation will probably become a more prominent principle of public policy in the 1980s. More data on this topic will sure be collected.

Satisfaction with experiences. Several surveys have measured people's satisfactions with their recreational experiences. This approach to measuring social good has been more effective at identifying the usually low percentage of malcontents than differentiating the subtleties of degrees and types of satisfaction. Interpretation of such findings are usually abstract, subjective, and not a particularly compelling argument in the policy arena. However, research linking subjective reports of satisfaction with various social, environmental and management elements of the recreation experience would aid managers in their planning efforts. Perhaps more importantly, subjectively reported satisfactions need to be linked to objectively determined social benefits of recreation. More research is needed before activity satisfaction can be described in convincing terms to the practitioner.

Constraints to participation. Some surveys attempt to identify constraints to participation through direct questioning. Although results provide greater insight into needs, the questions usually afford such general response that the need is at best obscure. For example, the 1977 national outdoor recreation survey included such a question (see Table 8). As vague as the results may be, this is the type of question which is more likely to reflect a more comprehensive perception of need than could ever be generated simply by a study of participation rates. In the future, this line of questioning will have to evolve so that needs as perceived by the public can be more fully understood.

Indicators We Have Little Experience Measuring

The following outdoor recreation parameters would provide valuable insight for the future but, as yet, we have little experience collecting such information.

Unmet expectations for participation. People frequently have preconceived expectations about recreation activity or areas which may relate to any one of a number of things such as scenery, wildlife, cleanliness, condition or type of facilities or type of fellow recreators. As conditions change at parks and recreation areas, the clientele using the areas may change as well. Increased crowding or a change in the type of people using an area, for instance, may go beyond the social tolerance of some people who then no longer visit the park. Their experience expectations were not met by conditions at the area

Measuring such a parameter is most difficult. Attempts at asking point blank questions on unmet expectations has tended to yield superficial results which most likely do not reflect the depth of respondent opinion, but the concept should be pursued in order to assess the preferences of both participants and non-participants.

Benefits from participation. If the constraints on public agencies continue in the 1980s, outdoor recreation will be in greater competition with other social services for public funds. In such an environment, the ability to articulate the variety of benefits derived from outdoor recreation activity made possible by the public sector would be most advantageous. As previously discussed, much effort has gone into estimating recreation benefits. Many approaches have been utilized but the results are frequently challenged. Benefit analyses have focused on quantitative parameters such as a visitor occasions or dollars expended. A challenge to the research community is to define subjective parameters which address both the more personal rewards of participation and the community-wide benefits afforded by recreation opportunity. If such subjectively based parameters were adopted and measured over time, powerful indicators would be likely to evolve.

Substitution of activity environs. If in the 1980s, the mobility of the population continues to decrease while the interest in outdoor recreation continues to expand, the need will grow for developing substitute environments for the outdoor recreation activities which today require substantial mobility for participation. Such insight would necessitate some appreciation for dimensions of satisfaction derived from participation and an assessment of whether or not those dimensions are transferable from one physical environment to another. Although substitution of recreation environments has not received much attention in the research community, there are indications that it will receive greater attention in the 1980s.

Roles of the public and private sectors. As the decade begins, providers of recreational opportunities from the public and private sectors are approaching the issue from different perspectives. The public sector, on the one hand, is faced with an ever increasing fiscal constraint and thinking and planning smaller. The leisure industry, on the other hand, is picked to be one of the major growth sectors of the 1980s and is thinking big. Equipment manufacturers, recreation facility developers, and near-home tourist attractions are in an expansionary mode. Such a situation would suggest that a shift in some roles will occur between the public and the private sectors. The monitoring over time of such shifts vis-a-vis facility and program inventories could prove to be useful in the policy arena.

ESTABLISHING SOCIAL INDICATORS IN OUTDOOR RECREATION

One must admit that the picture painted here is a sobering one at best. We have concluded that despite the collection of an immense amount of data over the last two decades, there is no clearly identified set of indicators in the outdoor recreation field. Circumstances which have contributed to this situation include the lack of consistent procedures and types of data collection over time, inadequate reporting of survey results, the difficulties in accessing existing data sets, and the limitations of past efforts to interpret data in terms of key policy issues. Furthermore, the broad perspective of potential human benefits derived from outdoor recreation experiences makes it most difficult to determine an all-inclusive set of measures covering this social good.

While identifying the problems that have impeded the development of an appropriate set of social indicators has been fairly straightforward, making meaningful suggestions for establishing useful indicators of outdoor recreation may be more difficult. As a way of expediting the establishment of such indicators, we offer the following suggestions:

Data standardization

Standardization should be introduced into recreational data collected by the public sector.

Collecting a standard set of core data as part of inventories and surveys would aid in making comparisons between studies and among studies over time. Appropriate candidates for standardization might include the names of recreational activities and facilities and specific demographic characteristics of respondents (participants and nonparticipants). For surveys, an index of commonly asked questions and how they have been phrased would be most helpful. Steps toward implementing such a goal have been initiated by a task force within the U.S. Department of the Interior charged with the establishing standard data elements for outdoor recreation surveys.

Data access

Recreation data should be made more accessible. As mentioned earlier, such an effort has been established for recreation surveys through the development of the National Leisure Archive at the University of Michigan's Institute for Social Research. To date, 30 data sets have been compiled in the archive. These sets have been made available by agencies of the federal government and various state governments. The data archive at the Institute is part of an inter-university consortium which has 240 member institutions world wide; these institutions have free access to the data. A similar type of mechanism needs to be instituted for recreation inventory data.

Data interpretation

Federal and state outdoor recreation policy makers should exert less energy on developing major reports on recreation studies and surveys and place greater emphasis on the interpretation of existing data vis-a-vis specific policy issues. The academic and research community should be called upon more often to contribute their expertise to this process. If policy makers begin to actively seek out information from existing recreation data, the most useful parameters to the policy arena will eventually surface. This process must take place if usable recreation indicators are to emerge. There is obviously no simple mechanism to realize such a goal, so the process will most likely evolve at an undetermined rate through the concerted efforts of inspired individuals.

Define conceptual framework

The research community should address the problem of developing a conceptual framework for categorizing social indicators and for evaluating their importance. Recreation researchers and practitioners come from many disciplines and organizations. Although this diversity has enriched the field, it has contributed to a lack of organizing principle for developing either a unified body of knowledge of social indicator measures or a methodology for collecting data. Development of such a framework would provide a focal point for future research efforts.

Identify key indicators now

At this time, we feel it is appropriate to offer a challenge to participants of this conference. We believe a special effort can be made to identify one or two key social indicators for outdoor recreation which would be systematically monitored in the future. Very specifically, we suggest that members of this conference "take the bull by the horns" and identify one or two line items for the "Mid-Decade" census and forward such recommendations for consideration by the Bureau of Census. At the very least, such an initiate will awaken those in the social indicator movement as well as ourselves to the fact recreation and leisure are important aspects of life which are influenced by public policy and which need to be understood over time.

LITERATURE CITED

Bevins, M.E., D.P. Wilcox. 1979. Evaluation of nationwide outdoor recreation participation surveys, 1959-1978. Burlington, Vermont: Vermont Agricultural Experiment Station.

Caplan, N., E. Barton. 1978. The potential of social indicators: Minimum conditions for impact at the national level, a suggestion by a study of the use of social indicators. Social Indicators Research.

Economic Research Associates. 1976. Evaluation of public willingness to pay user charges for use of outdoor recreation areas and facilities. Washington, D.C.: U.S. Government Printing Office Stock No. 024-016-00087-1.

Federal Recreation Fee Program. 1978. Washington, D.C.: Heritage Conservation and Recreation Service.

Geda, C. 1979. Data preparation manual for the national leisure archive. Ann Arbor, Michigan: Institute for Social Research, University of Michigan.

O'Leary, J., J. Peine, D. Blahna. 1980. Trends in day uses of parks and forests. Durham, New Hampshire. U.S. Forest Service Northeast Experiment Station. National Outdoor Recreation Trends Symposium.

Panel on Social Indicators. 1969. Toward a social report. Washington, D.C.: U.S. Government Printing Office.

Recreation Data Subcommittee. 1975. Regional recreation data program for the northwest. Vancouver, Washington: Pacific Northwest River Basins Commission.

Social Indicators 1973. 1973. Washington, D.C.: Executive Office of the President: Office of Management and Budget.

Social Indicators 1976. 1976. Washington, D.C.: Executive Office of the President: Office of Management and Budget.

Stowell, C. 1975. Evaluation of five previous nationwide citizen surveys. Washington, D.C.: Kirschner Associates, Inc.

Key to Tables 1, 3 and 4

Date - Year data was gathered

Agency (Table 3 only) - Federal agency sponsoring survey

- BLM - Bureau of Land Management
- BLS - Bureau of Labor Statistics
- BOC - Bureau of the Census
- COE - U.S. Army Corps of Engineers
- DOT - Department of Transportation
- FWS - U.S. Fish and Wildlife Service
- NPS - National Park Service
- TVA - Tennessee Valley Authority
- USCG- U.S. Coast Guard
- USFS- U.S. Forest Service

Administration (Tables 3 and 4 only) -

- I - Work conducted in-house
- C - Work contracted to a consulting firm

Universe Sampled(Tables 3 and 4 only) -

- N - Nationwide sample of general population
- O - On-site sample for a resource area
- R - Regional sample of general population
- S - Statewide sample of general population
- T - Tourist sampled from out-of-state

Cost - Estimated cost to conduct survey

Sample Size - Number of persons responding to the survey

Sample Techniques -

- D - Diary questionnaire
- H - Household interview
- M - Mail questionnaire
- P - Personal interview (face to face)
- T - Telephone interview

Subject (Table 3 only) - Key words of subject covered or of the resource area name.

Age Range (Table 1 only) - Minimum age of respondent

Response Rate (Table 1 only) - % of people contacted that participated in the survey.

Geo. Reliability - Geographic reliability

- C - data stratified by county
- R - data stratified by region
- S - data for statewide only, not stratified

# Activities - Number of recreational activities included in the questions asked.

Length of Recall - Length of past time respondent is asked to recall activity participation.

Period Conducted (Tables 1 and 4 only) - months that data was collected.

Question Content - Amount of survey instrument devoted to subject area:

- 0 - not included in survey
- 1 - briefly referred to in survey
- 2 - subject referenced by at least 2 questions
- 3 - subject major emphasis of survey

TABLE 1 - NATIONAL OUTDOOR RECREATION SURVEYS UTILIZED IN THE NATIONWIDE PLANNING PROCESS

Date	1960	1965	1970	1971	1972	1977*	1977**
Sample Size	3,817	7,194	26,450	3,258	4,029	4,029	13,729
Sample Technique	P	P	M	P	T	T	P
Age Range	12+	12+	9+	10+	12+	12+	12+
Response Rate	89%	91%	78%	81%	54%	54%	95%
Period Conducted	Sept.	Sept.-Oct.	Nov.-Dec.	Oct.-Nov.	Sept.-Oct.	June	Feb.-Nov.
# of Activities	20	28	14	11	31	30	30
# of Activities Strictly Comparable to 1977	15	20	5	5	18	--	--
# of Activities Roughly Comparable to 1977	5	6	7	4	12	--	--
Length of Recall	Summer	Summer	1 yr.	1 yr. except vacation	1 yr.	1 yr.	1 yr.
Question Content:							
Activity Participation	3	3	3	3	0	3	3
Satisfaction	1	1	0	2	0	3	3
Location of Participation	1	1	0	1	1	3	3
Transportation	1	1	0	0	1	1	1
Length of Stay	1	1	0	0	1	0	3
$ spent	1	0	0	0	1	0	0
Recreation Equipment	1	0	0	1	0	0	0
Deterence	0	0	0	0	2	3	3
Policy	0	0	0	0	0	2	2
Demographics	2	1	1	2	2	3	3

* National Outdoor Recreation Survey of the general population

** National Outdoor Recreation Survey of recreation on Federal lands

Source: Unpublished Report on the 1977 National Outdoor Recreation Survey

TABLE 2 ACTIVITY PARTICIPATION RATES FROM NATIONAL OUTDOOR RECREATION SURVEYS (PERCENT PARTICIPATION)

	Summer Rates			Annual Rates
Activity	1960	1965	1972	1977*
Picnicking	53	57	47	72
Driving for pleasure	52	55	34	69
Sightseeing	42	49	37	62
Swimming - Pool	45	48	18	63
Other			34	46
Walking for pleasure	33	48	34	
Playing outdoor games or sports	30	38	22	56
Golf		9	5	16
Tennis		6	5	33
Fishing	29	30	24	53
Attending outdoor sports events	24	30	12	61
Other boating	22	24	15	34
Bicycling	9	16	10	50
Nature walks	14 **	14	17	
Bird watching		5	4	
Wildlife and bird photography		2	2	
Attending outdoor concerts, plays	9	11	7	41
Camping - Developed	8	10	11	30
Wilderness			5	21
Horseback riding	6	8	5	15
Hiking	6	7	5 ***	28
Water skiing	6	6	5	16
Canoeing	2	3	3	11
Sailing	2	3	3	
Mountain climbing	1	1		
Visiting zoos, fairs, amusement parks			24	73
Off-road driving (motorcycles/other vehicles)			5/2	26
Other activities category	5		24	

* 1977 National Outdoor Recreation Survey by telephone
** Includes bird watching and photography
*** Includes mountain climbing

Source: Stowell, 1975, p. 104, for summer rates.
Unpublished Report on the 1977 National Outdoor Recreation Surveys for annual rates.

TABLE 3 - OTHER FEDERAL SURVEYS RELATED TO OUTDOOR RECREATION

AGENCY	BLM	BOC	BOC	BLS	COE	COE	COE	DOT	FWS	NPS	NPS	NPS	TVA	USCG	USFS	USFS
Date	1977	1977	1977	1972-1974	1973	1976	1976	1975	1975	1975	1976	1975	1976	1974	1970	1975
Administration	C	I	I	I	I	C	I	C	C	C	I	I	I	I	I	C
Cost (X 1000)	9	4000		1500		87			985	170	5.5	20				
Subject	Desert Plan	Long Travel	Short Travel	Vacation Cost	Nine Site Quality	McClellan Kerr	Urban Use	Access	Hunters Fishers	Smoky Mtns.	Sequoia Kings Canyon	Yosemite	Land Between Lakes	Boating	Wilderness	Campers
Universe Sampled	California	N	N	N	0	0	0	Boston Atlanta	N	0	0	0	0	N	0	N
Sample Size (X 1000)	1	18		64	3.3	22	.8	2	127	15	1.2	1.6	7.6	24	2.7	2.2
Sample Technique	P	P	P	P,T	H,H	P	P	T	T,M	T,P	P,S	H,M	P	T	P	T
Question Content:																
Activity Participation	3	0	0	0	2	2	2	0	2	3	1	2	3	2	2	2
Satisfaction	1	0	0	0	3	0	0	0	1	2	0	0	0	0	2	3
Location of Participation	0	3	3	1	0	1	0	2	0	3	0	2	0	0	0	1
Transportation	0	3	3	1	0	2	0	2	0	0	0	1	0	0	0	0
Length of Stay	2	2	0	0	0	1	2	0	1	1	1	1	2	0	1	0
$ Spent	[illegible]	0	0	3	0	3	0	0	3	1	0	1	0	0	2	0
Recreation Equipment	0	0	0	0	0	2	0	0	0	0	1	0	0	3	1	3
Deterence	2	0	0	0	3	2	0	3	2	1	0	2	0	0	3	2
Policy	3	0	1	0	0	0	2	0	1	0	3	3	1	0	3	2
Demographes	0	2	2	0	2	2	1	1	2	2	1	2	1	1	1	1

Source: Unpublished report on the 1977 National Outdoor Recreation Surveys

TABLE 4
Selected Statewide Outdoor Recreation Surveys

	Arizona	Colorado	Delaware	Florida	Georgia	Hawaii	Illinois	Indiana	Kentucky	Maine	Maryland	Michigan	Missouri	Nebraska	New Jersey	New Mexico	N.Y. (Tri-city only)	Ohio	Oregon	Oregon State Parks	Pennsyl-vania	Rhode Island	S. Dakota	Utah	Washington
Date	1977	1974	1978	1975	1976	1974	1977	1976	1977	1977	1978	1976	1973	1978	1976	1975	1976	1973	1975	1975	1974	1974	1974	1977	1976
Administration	C	I,C	I,C	C	I	C	C	C	C	C	I,C	I	C	C	C	C	I,C	C	C	I	C	C	C	C	C
$ Cost (X 1000)	41	32	30	34	59	43	145	13	25	16	45	79	60	6	80	15	30	130	6	20	130	125	33	25	125
Universe Sampled	T,S	T,S	S	T,S	S	S	T,S	S	S	S	S	S	S	S	T,S	S	R	S	S	T,S	S	S	S	S	S
Sample Size (X 1000)	38	9	16	2.5	2.4	5	10	5.6	5	1.5	6	18	12	2	2.6	2.6	3	5.5	2	22.	9	2	4.5	3.6	4
Geo. Reliability	C	S	C	R	R	C	R	R	R	C	C	R	R	R	C	R	C	R	C	To Site	S	R	R	R	R
Sample Technique	P	T	P	P	P	P	I	M	M	T	I,M	T	T	T	T,P	I,P	I	M	T	M	T	M,P	M	D	T,M
# Activities	40	56	25	24	53	20	18	24	30	42	30	Open Ended	36	27	56	40	13	21	22	14	19	18	24	72	81
Length of Recall	4 mo	1 yr	1 yr	1 yr	1 yr	1 mo	1 yr	1 yr	1 yr	1 yr	1 yr	2 wk	1 yr	1 yr	1 yr	1 yr	3 mo	1 yr	1 yr	per visit	1 yr	D	1 yr	1 yr	D
Period Conducted	Jan-Oct	Four Season	June July	Aug-Sept.	July-Aug.	June-Aug.	Oct.-Jan.	Sept-Dec.	July	Jan-March	July-Jan.	Summer	July-Aug.	April	Aug.	May-June	Aug-Sept.	Winter Spring	Sept.	Summer	July-Sept.	Four Season	Summer Fall	Four Season	Four Season
Question Content:																									
Activity Participation	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	1	3	3	3	3	3
Satisfaction	1	0	1	0	0	0	0	1	0	0	1	0	0	2	0	1	2	2	1	1	1	1	0	0	0
Location of Participation	0	0	2	1	1	1	1	1	1	1	2	2	0	0	1	1	1	1	1	2	1	1	0	2	2
Transportation	2	0	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	1	0	1	2	1	0	0	0
Length of Stay	1	0	0	1	1	1	1	1	0	1	2	0	0	0	1	1	0	[illegible]	0	1	1	1	0	1	1
$ Spent	0	0	2	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	1	0	1	0	0	0
Recreation Equipment	1	0	2	[illegible]	0	0	0	0	0	1	1	0	0	1	0	0	0	0	0	1	1	2	0	0	0
Deterence	1	0	2	0	0	0	0	2	0	0	2	0	0	0	0	1	2	2	0	0	1	1	0	0	1
Policy	0	0	2	1	0	0	1	0	1	2	1	3	0	0	0	0	0	2	0	3	1	0	0	0	0
Demographics	2	1	2	1	2	0	2	1	1	2	2	1	1	2	1	1	2	1	1	1	2	2	1	2	1

Source: Unpublished report on the 1977 National Outdoor Recreation Surveys

TABLE 5 - COMMERCIAL OUTDOOR RECREATION SURVEYS OF THE 1970's

	New York Zoological Society	Hawes, Blackwell Talarzyk	National Opinion Research Center	Nielsen	Nielsen	Sindlinger	Nielsen
Date	1970	1972	1973	1973	1976	1977	1979
Universe	N	N	N	N	N	N	N
Sample Size	944	1,015	692	9,600	9,600	4,616	9,600
Sample Technique	P	M	P	T	T	T	T
Length of Recall	1 year	1 year	Last month	From time to time	From time to time	Last week	From time to time
Number of Activities	5	15	12	23	27	28	30

Source: Unpublished Report on the 1977 National Outdoor Recreation Surveys.

TABLE 6 - Participation Trends From Neilson Surveys

(RANKING OF POPULARITY OF PARTICIPATION IN SPORTS MEASURED
1979 vs 1976 vs 1973 Sports Participation Surveys)

Rank	Sport	projected individual participants (000)	% change in projected participants 1979 vs 1976	projected individual participants (000)	% change in projected participants 1976 vs 1973	projected individual participants (000)
		1979		1976		1973
1	Swimming	105,441	+2%	103,503	-3%	107,191
2	Bicycling	69,810	-7%	75,015	+14%	65,613
3	Camping	60,300	+4%	58,102	+7%	54,435
4	Fishing	59,275	-7%	63,901	+4%	61,263
5	Bowling	43,330	-2%	44,434	+16%	38,218
6	Boating	37,920	+8%	35,230	+8%	32,629
7	Jogging/Running	35,727	*	*	*	*
8	Tennis	32,271	+10%	29,201	+45%	20,158
9	Pool/Billiards	31,937	-11%	35,805	+9%	32,920
10	Softball	28,458	+4%	27,268	+3%	26,362
11	Table Tennis	26,908	-16%	32,215	-4%	33,501
12	Roller Skating	25,359	*	*	*	*
13	Basketball	24,048	-7%	25,818	+17%	22,129
14	Hunting	19,711	-4%	20,480	+2%	19,997
15	Ice Skating	18,924	-26%	25,772	+4%	24,875
16	Water Skiing	16,922	+15%	14,681	+5%	14,021
17	Golf	15,897	-4%	16,568	-3%	17,025
18	Snow Skiing	15,397[†]	+40%	10,999	+42%	7,721
19	Baseball	15,039	-4%	15,670	+3%	15,216
20	Football	14,300	-4%	14,911	+5%	14,247
21	Racquetball	10,654	+283%	2,784	*	*
22	Motorbiking	10,511	+8%	9,734	-14%	11,339
23	Sailing	8,652	+19%	7,271	+4%	6,978
24	Snowmobiling	8,628	-6%	9,204	+19%	7,753
25	Soccer	6,530	*	*	*	*
26	Handball	5,578	+1%	5,546	*	*
27	Archery	5,529	+1%	5,477	-6%	5,847
28	Paddle Tennis	2,431	-6%	2,577	*	*
29	Ice Hockey	1,668	-38%	2,669	-18%	3,263
30	Platform Tennis	405	+120%	184	*	*
Total U. S. Population		214,958	+2%	210,019	+2%	205,950

[*] Not measured in 1973/1976.

[†] Includes downhill and cross-country skiers.

Source: News Release By The Neilson Company

TABLE 7 - A COMPARISON AMONG SURVEYS OF THE EFFECT THAT GASOLINE PRICES HAVE HAD ON OUTDOOR RECREATION

Year	Survey and Question	Percent
1974	State of Ohio How important is the cost of gasoline in your participation in outdoor recreation?	47% very important
1975	COE at McClellan Kerr site How has the price of gasoline (shortage) affected your recreation related travel plans? (1975 compared to 1974)	29% fewer trips 28% shorter trips
1976	State of Indiana Has energy or economic changes during the previous year affected your outdoor recreation involvement? How?	38% yes and of those... 59% fewer trips away from home 32% closer to home 29% stopped participating in some activities
1977	State of Arizona (Has) the increase in price of gasoline over the past several years affected how much your family uses (gasoline consuming) equipment for recreational purposes?	44% much or a little less use
1977	HCRS General Population Survey Has the present price of gasoline caused you to take shorter trips for outdoor recreation activities?	49% yes
1978	State of Maryland Has the present price of gasoline caused you to take shorter trips than you normally would for outdoor recreation activities?	42% yes

---

Source: Unpublished Report on the 1977 National Outdoor Recreation Survey

TABLE 8 - REASONS PREVENTING USE OF PARKS OR RECREATION AREAS

(percent)

Reason	Type[1/]	General Population −	Federal Estate Population =	Percent Point Differ
Lack of time	P	52	52	0
Area too crowded	A	43	40	3
Lack of money	P	37	24	13
Lack of information	A or P	32	12	20
Recreate at residence	P	30	4	26
Area not convenient	A	29	10	19
Area polluted	A	25	8	17
Lack of interest	P	22	4	18
Personal health	P	21	6	15
Area poorly maintained	A	20	10	10
Lack of transportation	P	20	8	12
Area safety problems	A	19	4	15

Note: [1/] P = Personal situation
A = condition perceived for Area

Source: Unpublished report on the 1977 National Outdoor Recreation Survey

THE ROLE OF FUTURES FORECASTS IN RECREATION: SOME APPLICATIONS IN THE THIRD NATIONWIDE OUTDOOR RECREATION PLAN[1]

Meg Maguire and Dana R. Younger[2]

Abstract. -- This paper provides a quick glimpse into the theoretical applicability and importance of futures forecasting techniques in recreation policy planning. The paper also details contemporary socioeconomic trends affecting recreation, current recreation participation patterns and anticipated social changes which will alter public recreation experiences as developed in the Third Nationwide Outdoor Recreation Plan.

OVERVIEW OF FUTURES FORECASTING TECHNIQUES AND RECREATION

One of the best ways of discerning meaningful trends in recreation is through use of the techniques collectively known as futures research. Trend anaylysis specifically and futures research generally are important instruments to make policymakers aware of change and which ultimately help us deal creatively with change. However, the value to be derived from application of a futures prespective to recreation will depend on the degree to which it is possible to anticipate future events and also, the extent to which it is possible to respond to new circumstances. If a society can clearly map out the future, but cannot plan for or react to that future's environment, then it is debatable whether information about the future is of much value.

Where there is a slow rate of change between the past and the future, society can maintain relatively rigid mechanisms and can largely ignore the future. In such situations, dislocation costs can be spread over a lengthy period of adjustment. As we enter the 1980's, we find ourselves ina situation where the rate of political, technological and cultural change in the world is quickening, and the future is placing its assertive demands on the present. We are entering a period of profound social change which affects recreation as well as the rest of the fabric of American society. The present recreation picture is changing rapidly and future patterns are likely to be equally divergent. The ability of our society to adapt to meet these new social needs hinges not so much on sophisticated technological innovation as on institutional and societal innovation.

---

[1] Paper presented at the National Outdoor Recreation Trends Symposium, Durham, NH, April 20-23, 1980.

[2] Meg Maguire is Associate Director for Recreation Programs, USDI, Heritage Conservation and Recreation Service, Washington, D.C. and Dana Younger is an Outdoor Recreation Planner in the Division of Nationwide Recreation Planning, USDI, Heritage Conservation and Recreation Service, Washington, D.C.

In order for futures research in parks and recreation to have any impact, it must succeed in re-orienting decisionmakers away from short-term, reactive planning. Most decisionmakers place highest priority on those factors which relate to the immediate consequences of their actions while ignoring long-term consequences. Herbert Kahn (1967), perhaps the dean of futurists, suggests that the objectives of futures research should be, "...to put policy-makers in a position to deal with whatever future actually arises; to be able to alleviate the bad and exploit the good."

While we may not agree with Epicurus that, "No means of predicting the future really exists," we must recognize that our tools of prediction are crude at best. Nevertheless, the challenge of planning for the future is such that we must proceed regardless of the limitations of our current techniques. We must also recognize, as many futurists already have, that futures research and trend forecasting are more of an art than a science. As Solomon, Marstrand and Page (1975) point out in their lively book, The Art of Anticipation, "Forcasting is an uncertain exercise, plagued with fallacies, uncertainties and ignorance. It cannot aspire to be called a science and it must avoid the dangers of pseudo-science. It requires an imaginative synthesis between what is known and what is indefinite. This is properly described as an art or a craft."

To summarize, the art of future speculation can offer glimpses of symptoms of the future which can alter the prespective of decisionmakers -- to encourage them to invest in decisions which will deal with future conditions as well as present or past conditions. This preparedness for future events has become more relevant now than it was in the past, due to the current rate of change which increases the need to make decisions about diverse conditions and increases the costs of bad decisions and non-decisions for society. The park and recreation movement is a vital part of society and includes people who believe in improving the quality of life. To believe in this concept and to operationalize it requires that individuals bring flexibility into existing institutions.

APPLICABILITY OF FUTURES FORECAST IN HCRS RECREATION POLICY PLANNING

The creation of the Heritage Conservation and Recreation Service (HCRS) in 1978 reflected such a commitment on the part of the Carter Administration to improve the making of public policy for recreation, natural resource protection and historic preservation. Advocacy of the National Heritage Policy Act; protection of Barrier Islands; improved administration of both Federal and State sides of the Land and Water Conservation Fund; implementation of the Urban Park and Recreation Recovery program; and preparation of the Third Nationwide Outdoor Recreation Plan all indicate HCRS's attempts to anticipate future needs.

However, futures forecasting has different meanings and operates toward different goals depending on the level at which it is developed. Obviously, the forecasting needs of an individual park manager are very different from those of an administrator responsible for overseeing many varied facets of park and recreation planning. Strategic long-range planning and policymaking in HCRS's business requires some indication about what conditions will prevail several years hence.

The most important requirement of such long-range futures forecasts is that they capture the unexpected. Many things will certainly continue in rather predictable patterns. However, it is the unexpected development, often produced by the interaction of predictable existing patterns that is most elusive. The value of these more speculative types of long-range futures forecasting is that they attempt to predict the "unpredictable" types of events which have sweeping effects on established trends. The techniques used in these exercises are usually based on more imaginative, subjective processes as opposed to structured, quantitative ones.

It is difficult to know how to recognize a valid forecast amidst the many wild guesses. However, the main value of long-range forecasts is not in their accuracy. There are simply too many intervening events to be able to describe with any great degree of precision what, for example, the nature and use of national parks will be in twenty-five years. The value of long-range forecasts and studies of recreation trends lies in their ability to sensitize planners and policymakers to the ranges of possibilities that await them just beyond the horizon of what can be predicted or foreseen. Although accuracy in terms of timing and magnitude of events is desirable, the prime objective of long-range futures forecasting is to reveal the full spectrum of possibilities that might be realities in five ten, twenty or thirty years.

This is particularly relevant to those of us in the Federal government who are guardians of the public trust in administering public lands for park and recreation purposes. We have the responsibility to ensure that the public values presently preserved and enhanced on these lands survive to be used and enjoyed by future generations. Forecasting is also important because the development of a single park, from first conception, through land acquisition, to eventual recreation development may take up to twenty years to complete. Long-range forecasting will become even more relevant to park planners and managers in years ahead as fiscal compression increases, as our nation's natural environments are depleted and transformed, and as all basic land use decisions take on still greater importance.

Keeping in mind that each of us will spend the rest of our lives in the future, many of us actively shaping recreation policy, we would like to share with you some of the insights and accomplishments of our new Nationwide Recreation Planning Process, which culminated on December 11, 1979 with the President's transmission of the Third Nationwide Outdoor Recreation Plan to the Congress. Within the limits of existing information, this Plan's Assessment sought to discern many trends in contemporary recreation, and to anticipate future treads. The Plan's Action Program developed responsive policy options to ease the transition of recreation into the future in America.

Before proceeding with a discussion of the findings of the Plan's Assessment, it is important to say a word about the data sources used in this document, as well as about the general limitations on data in the park and recreation field. Inconsistent or nonexistent data bases place real limits on the degree of accuracy that is possible in trend analysis.

As you are perhaps all well aware, data collection and evaluation in the park and recreation field are not as strong as they should be. At the national level, data is incomplete, out of date, or simply unavailable. There is also wide variation between agencies and recreation professionals over what quantitative and qualitative measures are most appropriate as indicators in the recreation field. The long-standing debate over qualitative recreation output measures epitomizes this problem.[3] Therefore, the production of accurate, longitudinal data on recreation and its relation to important national concerns is a critical long-range need.

Variability in available data bases and their aggregation made the preparation of forecasts for the Assessment somewhat problematic. Nevertheless, in the relatively short time frame of two years, a compilation of the best available information was made. We were forced to rely heavily on non-park and recreation sources for key trend information. First and foremost, however, we used data from the latest Nationwide Outdoor Recreation Survey, completed in 1977. The data collected during the survey show the relationship between certain socio-demographic variables such as age, sex, education, income, etc. and rates of participation in selected outdoor recreation activities. One component of the survey involved a subsample of 14,000 interviews with visitors onsite at 155 Federal recreation areas. Many of you may be interested in the findings which compare public recreation use between the different recreation-providing Federal agencies.

---

[3] In the area of quantitative measures, while agreement now exists among Federal recreation agencies to use "recreation visitor days" or "visitor hours" as the basic unit of recreation output measurement, there is still no standardization of data collection techniques. In the area of qualitative measures, there is considerable disagreement as to how to measure the quality and cost-effectiveness of recreation outputs. While some qualitative values can be measured in economic terms, noneconomic benefits pose difficult measurement problems. These and other related problems were discussed at a recent "Workshop on Recreation Output Measures" held December 11 - 14 at Harper's Ferry, W. Va. The workshop proceedings will be published sometime during 1980. [personal communication, Beverly L. Driver, USDA-Forest Service Experiment Station, Ft. Collins, Colo.]

In addition to survey data which was analyzed and interpreted, significant trend information was distilled from various reports prepared by the U.S. Census Bureau on such parameters as population projections, geographic mobility, family size, etc. Planning studies, research reports and data provided by the key recreation-providing Federal agencies were studied for evidence contributing to trend analysis. Reports and policy documents from other Federal agencies were also scrutinized. Significant recent findings of the Departments of Labor; Health, Education and Welfare; Transportation; Agriculture; Commerce; and others were included.

In the next few years HCRS will seek to improve still further the collection and analysis of meaningful data on national recreation trends. While improved data collection will clearly benefit many in the park and recreation field, at least part of the argument for more refined data is based on a somewhat selfish motive. If we assume that more decisions will be subjected to powerful public and political scrutiny, then we need refinements in the policy planning information base in order to help withstand criticism.

CURRENT TRENDS IN RECREATION

The number of participants in outdoor recreation has grown substantially, and their demographic make-up has changed to include people with significantly different social and economic backgrounds than those of recreationists in years past. The qualitative changes in the recreating population reflect more than just a higher standard of living and expanded leisure time; they can also be attributed to a redefinition of society's values, new economic forces, and advanced technology. Recreation managers and policy makers must be aware of these evolutionary cultural changes if they hope to grasp the nature of contemporary recreation trends and their implications for the future.

Numerous changes in the number, location, character, and recreation interests of America's recreationists are occurring and will be likely to continue for the next ten years. The 1977 Nationwide Outdoor Recreation Survey reveals that recreation continues to be an activity of great importance to most Americans. Eighty-six percent of Americans surveyed indicated that recreation remains one of their most important interests. Other surveys show that some 90 million adult Americans engage in recreation activities on a regular basis.

The latest available figures also show that recreation is of tremendous importance to the national economy. Recreation expenditures now account for nearly $200 billion. This amount dwarfs the five to seven billion dollars of Federal, State and local public expenditures spent annually on recreation. Nearly $1 out of every $8 spent by consumers went for recreation. In addition to its burgeoning economic impacts at both national and regional levels, recreation contributes significantly to maintaining the physical and mental health of Americans. This contribution is only beginning to be adequately appreciated.

The sharpest changes in recreation participation in the future are due to broader underlying demographic trends. Our nation's population is aging steadily and future recreation planning must adapt to meet new demands. The median age of Americans will rise steadily over the next twenty to thirty years as the post-World War II "baby boom" age cohorts move into maturity. The median age will top 30 years in 1980 and reach 35.5 by the year 2000. All of this will bring important changes in recreation. Birth rates are expected to remain low, so that the numbers of those in so-called "prime recreational years" from 12 to 25 will continue to decline through the year 2000. However, the increasing emphasis on physical fitness will likely extend the life cycle of popularity for many activities even past the traditional ages of declination.

Inevitably, recreation planners will face the needs of an older population which is healthier, interested in recreation, retiring earlier, living longer, and one with more available income than its predecessors. The Census Bureau reports that 65 year olds now exceed 23 million and projections indicate that this age group will increase by one-half million individuals per year over the next decade. While the recreation market for the elderly will sharply increase, many cities are still having difficulty providing adequate senior citizen recreation programs. More outreach and special transportation services are especially needed.

Recreation planning must also respond to changes in the population's location. The Census Bureau has documented the shift in population from older, industrialized areas of the Northeast and Midwest to Sunbelt States. These areas are expected to grow twice as fast as the Northeast and North Central States in the next twenty years. There is also a perceptible "back to the city movement" in many urban core areas, and more Americans than ever before, some 72 percent, make their homes in urbanized areas. This trend will continue to put pressure on park and recreation systems to expand their land and facilities in new, growing areas and to maintain existing land and facilities through innovative measures in declining areas.

Other important socioeconomic trends affecting recreation include the following. The average household size is declining, divorce rates and the number of unmarried couples continue to grow simultaneously, all impacting the family unit, traditionally the molder of an individual's recreation participation. Today, there is a greater need than ever before for recreation to play a stabilizing role, to provide a sense of community and family for those lacking this structure.

There are also substantial increases in the pursuit of high-risk recreation activities among young adults. Sports activities such as rock climbing, hang gliding, scuba diving and off-road vehicle use are examples of this trend. Sociologists' attribute these tendencies to technological innovation in recreation equipment and the psychological benefits accruing to participants, such as relief from stress and boredom.

Sex-related differences in recreation participation are rapidly diminishing. More women than men are now starting many recreation activities. This sex-based equality is particularly evident among the young where women are actively participating in many sports traditionally dominated by men. Women's participation in high school and college athletics is also showing steady growth spurred by Title IX. This trend will likely boost still further the sales of recreation equipment, particularly for those products directed to women's markets.

Other factors likely to affect recreation in the years ahead are income levels. Rising amounts of disposable income have fueled the current leisure industry boom and there is good evidence that expenditures for recreation and leisure activities are rising even faster than consumer spending as a whole. Although real income levels may taper off due to inflation and stagnant productivity, a countervailing trend is the growth of dual income households.

Americans also have more leisure time now than ever before, and are better educated than at any previous time in our nation's history. Much of this additional leisure time is being devoted to recreation and there is a clear correlation between higher educational levels and greater recreation participation. Americans now have larger blocks of holidays and vacations in part due to smaller families, a shorter work week, and time-saving technological innovations. There has also been a continuing decrease in the proportion of an individual's life spent at work, a trend supported by extended schooling periods, earlier retirements and shorter working hours. Results from the 1977 Nationwide Outdoor Recreation Survey show that participation in recreation activities will continue to diversify and grow. According to data on new starts, the ten activities showing the fastest growth are: cross-country skiing, downhill skiing, tennis, sailing, snowmobiling, water skiing, canoeing/kayaking, golf, off-road vehicle use, and horseback riding. Similarly, those with the highest potential for growth are: downhill skiing, tennis, water skiing, horseback riding, cross-country skiing, tennis, primitive area camping, sailing, golf, snowmobiling and canoeing/ kayaking.

Our colleagues in the USDA-Forest Service (1980) have come up with projections of recreation participation stretching out to the year 2030 which show that while recreation will grow substantially, snow-based recreation activities will grow the fastest, followed by water and then land-based activities. Factors such as the anticipated growth in population, income, and education all contribute to the projected increases in outdoor recreation participation. However, these increases will not be as great as the extremely large growth in participation experienced during the 1960's. Several factors which may further dampen these growth rates are: the population's changing age structure and rising energy costs.

Our analysis in the 1977 Survey of Federal estate visitation to national parks, forests, wildlife refuges, recreation areas, historical sites, Corps of Engineers lakes and reservoirs, and other Federal resource lands, clearly shows that users of Federal recreation areas are not a representative cross-section of the general population. Users of the Federal estate have higher levels of income and education, and are considerably older than their average counterparts in the general population. This disparity is most evident for visitors to National Park System sites (HCRS, 1980).

Also, since most Federal recreation areas are located more than 100 miles from the majority of the American population, a significant percentage of Americans cannot easily reach Federal recreation areas regardless of whether the areas are located in the West or the East. The 1977 Survey shows that these travel distances vary dramatically among the ten Federal regions. The Survey also shows that recreation on the Federal estate is largely a group activity, and that most groups contain children. In addition, the larger a group is, the more likely it is to stay at the site for an extended visit.

The reasons visitors choose particular Federal areas vary dramatically. Corps of Engineers' visitors cite the availability of good facilities; Forest Service users cite scenic beauty; and National Park System visitors are most likely to cite a desire to visit new areas. The most popular activities at Federal recreation areas are closely related to natural features of the landscape, with sightseeing and camping topping the list.

Users of the Federal estate share a similar concern with the general population over lack of time and crowded conditions as the key constraints or deterrents to participation. Of those expressing dissatisfaction with the Federal estate, half of all complaints centered on facilities. Many of the unmet expectations expressed by visitors, such as low water levels in reservoirs or inability to view wildlife, cannot be readily corrected by agency managers.

While many of the projections for recreation point to increasing although moderate growth, recent developments concerning energy costs cast doubt on these forecasts. Recent oil price increases, last summer's spot shortages, and the prospect of still higher prices, inflation, and intermittent shortages for the foreseeable future lessen the chances for sharp growth increases in outdoor reccreation. Although verified quantitative relationships have not yet been fully established, economic analysis of fuel costs and the amount of travel undertaken indicates that a negative or inverse relationship exists (Goeldner et al. 1975). Since most Federal and regional destination recreation areas are oriented to visitors traveling by private car, use levels will continue to respond to gas prices and supply effects. The best current evidence suggests that future increases in recreation participation will be determined, as many other items in the consumer budget will be, by the relative price and income elasticities of household energy and travel expenditures. Energy problems will also affect public park and recreation management.

While personal mobility increased tremendously in the past three decades, the 1980's loom as a period of adjustment to scarcity of available energy resources and pose the imperative to utilize energy more efficiently. Other key trends in recreation as a result of energy instabilities include the following. Fuel costs will rise and supplies will tighten still further. All facets of recreational travel will become more expensive. The public will take fewer and shorter recreation trips. More recreation will take place at alternative sites close-to-home. Lower and middle-income groups will be affected most severely by higher prices and reduced mobility. Demand for alternative transportation modes to recreation opportunities will increase, particularly for transportation to remote recreation areas.

Reductions in visitor use of more remote national parks, national forests and other congressionally designated recreation areas is particularly likely. Adverse effects will also occur at those parks or recreation areas that feature energy-intensive forms of recreation. The economic effect of such use reductions will strongly affect the travel and recreation industries. Conversely, substitution effects will increase visitor pressure and public demand at large urban or regional parks as well as at those recreation areas which are within 100-300 miles of major metropolitan areas.

The public is also likely to take more group-type vacations. There will be increased recreation planning attention for those who cannot afford cars; and increased development of, and consumer investment in, more efficient recreation vehicles and automobiles. Experts also expect a return to destination-type recreation facilities and a consequential concentration of travel patterns.

It is probable that the national search for new energy sources will degrade the quality of some recreation areas and increase pressure to allow energy resource exploration and development in wilderness areas, national parks and other protected lands. Park and recreation agency involvement with energy conservation and alternative energy resources to help meet operating needs will also increase.

While all of the Assessment's trend data cannot be summarized in this limited paper, other important trends affecting recreation as analyzed in the Assessment are also briefly developed. In the area of government park and recreation services, fiscal constraints will cause reductions in staff and curtailment of programs. The price of prime recreation land will continue to rise and funds available to purchase lands will fall short of demand, particularly in urban areas. There will be increased development of more innovative less-than-fee land protection and acquisition techniques as well as greater imposition of recreation fees. Provision of economic incentives to motivate land owners to open lands for public recreation will grow and innovative urban recreation spaces will be utilized increasingly; for example, waterfront redevelopment, industrial area reclamation, and redesign of deteriorating parks. There will be growing recognition of interdependence between private and public sectors, producing a rethinking of traditional business relationships, including changes in concessions policies, and increased reliance on government use of contractual services. Construction of new facilities which lack long-term operations and maintenance commitments will probably decline, while better techniques of fiscal management in recreation administration rapidly develop.

For natural resource management, the future looms as a time of better understanding of ecological factors affecting resource-based recreation areas. There will be greater reliance on park, forest and land inventories to grasp resource management challenges. Resource managers will be better trained in integrated management to help cope with multiple use conflicts and carrying capacity limits. However, there will be increased control over public recreation usage in natural and developed recreation resource areas through time and space rationing. Greater conflicts between recreation and non-recreation uses of lands, and heightened conflicts between different types of recreation users are also likely. Some decline in the quality of recreation experiences due to congestion and over-crowding will probably occur although public recreation activities such as nonconsumptive uses of wildlife will continue to grow.

Several changes in public participation in park and recreation agencies are also likely. Institutionalization of improved public participation processes will occur at the local level. There will be greater involvement by private non-profit groups in the provision of public recreation services through contractual arrangements. Involvement of volunteers, the handicapped, the elderly, and minorities in the design of recreation services and the management of services will grow. There will also be greater information dissemination to the public and the institution of new public input mechanisms in the Statewide Comprehensive Outdoor Recreation Planning process.

The growing diversity in public recreation demands caused by market diversification, specialization, and segmentation will affect the private sector in years to come. The private sector is likely to play a still greater role in meeting new recreation demands. The private sector will increase technological innovation in recreation equipment to conserve energy and raw materials while simultaneouly enhancing the public's recreation experiences. Foreign tourism will grow even more due to favorable exchange rates and the range of America's scenic, recreational and historical attractions. There will also be an increase in industrial recreation or opportunities at the workplace due to recreation's positive effects on productivity.

CONCLUSION

While all the trends and issues described in the Third Nationwide Outdoor Recreation Plan's Assessment are not repeated here, it is clear that more precise information about the future is still needed. Accurate long-range forcasting will require availability of adequate time and resources to do the job conscientiously, and managerial commitment to the use of forecasting as a means of keeping sensitized to the need for changes. While we are beginning to get a better grasp on many of the structural trends unfolding in recreation, more information is still needed. There is a great need for better "user-needs" assessments to reveal latent public demands. Better data on regional recreation differences is also needed so as to anticipate the spatial distribution of new recreation demand.

Despite many pessimistic projections, these are dynamic times for recreation and creativity is essential to galvanize future actions to strengthen and support recreation. Recreation has increased stature in public policy discussions due to the growing use of recreation and park development to meet economic objectives, community revitalization and health promotion needs, among others. Even though Epicurus was right when he said, "No means of predicting the future really exists," futures forecasts are one important tool to help illuminate future trends and possibilities for policymakers. The projections of recreation's importance in the 1980's, developed for the Third Nationwide Outdoor Recreation Plan, leave one with reason for optimism despite the difficult challenges they pose for public recreation agencies.

LITERATURE CITED

Goeldner, C., K. Dicke and Y. Sletta. 1975. Travel Trends in the United States and Canada. Business Research Division. Graduate School of Business Administration. University of Colorado. Boulder, Colorado. pp. 8-11.

Epicurus. Book 10, Section 135.

Kahn, H. and A.J. Wiener. 1967. The Year 2000 - A Framework for Speculation on the Next Thirty-three Years. MacMillan Co., Inc. New York, N.Y.

Solomon, E., P.R. Marstrand and W. Page. 1975. The Art of Anticipation. Martin Robertson Press, London, U.K.

U.S. Department of Agriculture, Forest Service. 1980. An Assessment of the Forest and Range Land Situation in the United State. U.S. Government Printing Office. Washington, D.C. [Prepared as a supporting technical document to the Report to Congress on the Nation's Renewable Resources--RPA Assessment and Alternative Program Directions, as required by the Forest and Rangeland Renewable Resources Planning Act and the National Forest Management Act.]

U.S. Department of the Interior, Heritage Conservation and Recreation Service. 1980. The Third Nationwide Outdoor Recreation Plan. U.S. Government Printing Office. Washington, D.C. [The Plan is a multi-volume compilation. This article cites findings contained in Volume II - An Assessment of Outdoor Recreation and Appendix I: Nationwide Outdoor Recreation Survey Summary. Data tapes of the 1977 Nationwide Outdoor Recreation Survey are available from HCRS, Division of Systems Management, 440 G Street, N.W., Washington, D.C. 20243.]

TREND INDICATORS NEEDED FOR EFFECTIVE RECREATION PLANNING--A STATISTICAL BLUEPRINT FOR THE 80's [1]

H. Fred Kaiser and George H. Moeller [2]

Abstract.--Here we outline important elements in recreation planning and describe how the process is changing, using Federal land management agencies as our example. We outline some factors that will impact on planning in the 80's, encourage establishment of a system to monitor trends in key factors that influence recreation behavior.

THE CHANGING PLANNING PROCESS

More than ever before, future outdoor recreation planning decisions will require reliable, up-to-date trend information not only about what the American people are doing, or not doing, for recreation, but what they plan to do and the factors that will influence what they plan to do. In the past, application of outdoor recreation planning concepts to on-the-ground management has been largely informal and intuitive, particularly in cases where conflicts over resource allocation have not been intensive. For many years, the success of judgmental or subjective planning methods were measured by continuing political support and relative lack of controversy over land use policies.

But the situation has changed as pressures mounted in recent years. Protests and court suits have increased as resources have become more scarce. The environmental movement of the 1960's and early 1970's led to Federal legislation, regulations, and executive orders that required increased attention to the environmental consequences of Federal actions, including those resulting from management of natural resources. Legislation, such as the National Environmental Policy Act of 1969 with its requirements for environmental assessments and impact statements, generated new needs for information on participation in outdoor recreation.

A more recent demand has come from Federal legislation requiring renewable natural resource appraisals to guide national policies and programs, as well as accelerated planning for management of Federal lands. In 1974, the Congress enacted the Forest and Rangeland Renewable Resources Planning Act (RPA). This legislation authorized the Forest Service to conduct periodic assessments of the renewable resources on all of the Nation's forest and rangelands and to identify management needs, opportunities, and alternative programs. The National Forest Management Act of 1976 requires that land and resource management planning be completed on all National Forests by 1985, thus generating an additional major need for outdoor recreation information. The Federal Land Policy and Management Act of 1976 requires the Bureau of Land Management to develop multiple use management plans for lands under its administration and to inventory the resource values of the public lands in order to identify changes and emerging resource needs. Under the provisions of the Soil and Water Resources Conservation Act of 1977, the Soil Conservation Service is conducting periodic appraisals of the soil, water, and related resources of the Nation. The purpose of this appraisal is to assure that the Department of Agriculture's programs for management of soil, water, and related natural resources address long term needs.

The effects of these legislative developments has been to stimulate a major need for outdoor recreation information. For instance, in the National Forest System, local and regional land and resource plans are being prepared to establish long range outdoor recreation priorities. To satisfy RPA requirements, Regions must compile outdoor recreation information for the National Assessment and Program, appropriate RPA program targets for outdoor recreation to individual National Forests, and coordinate these planning activities with State and other agencies.

---

[1] Paper presented at the National Outdoor Recreation Trends Symposium, Durham, NH, April 20-23, 1980.

[2] H. Fred Kaiser, Economist, Resources Planning & Assessment Staff, and George H. Moeller, Forest Environment Research Staff, Forest Service, Washington, D.C.

The relationship between the RPA Recommended Program and land management planning and the annual budgeting process is now guided by Section 6 of the National Forest Management Act of 1976. That section requires formulation of a detailed planning system for program coordination. In essence, what was required was refinement of a process that has been evolving within the Forest Service for many years. Some key characteristics of this system are:

- o Allocation of resource production targets based on resource capability of each administrative unit and on relative efficiency of production.
- o Regional Foresters utilizing assessment findings and the National RPA Program to prepare regional plans. These plans will show how outdoor recreation targets are distributed among National Forests within each Region.
- o Using the assigned target range and local information on capabilities, each National Forest prepares a plan for accomplishing assigned targets. Specific aspects of this formulation are:

  (1) Development of a 4-decade program for outdoor recreation outputs for each National Forest based on the RPA Recommended Program.

  (2) Development of a 10-year outdoor recreation activity program for each National Forest based on the RPA Recommended Program, including appropriate National Forest-wide administrative support, transportation, resource protection and public safety activities.

  (3) Identification of land units at the National Forest level, from which outdoor recreation outputs or combinations of outputs could be produced, and of the appropriate activities and investments necessary for production of these outputs. This identification will come from the inventory information base for each National Forest; and

  (4) Conduct environmental and benefit-cost analyses of the relative efficiency of production from each resource unit or group of resource units with similar characteristics.

  (5) Identify major outdoor recreation issues and demonstrate program responsiveness to these issues.

As other agencies have found out, assessing the demands for outdoor recreation in order to plan for future programs is a complex undertaking. Outdoor recreation covers a wide range of activities and the use of diverse combinations of natural resources, management, and facilties. In addition, recreationists' tastes are known to change with technology, availability of leisure time and economic conditions, among other factors.

In the past, the Heritage Conservation and Recreation Service and its predecessor, the Bureau of Outdoor Recreation, have evaluated the demands for outdoor recreation by conducting national surveys of outdoor recreation participation. States have also conducted surveys patterned largely after these national surveys. Two basic types of information were collected: data on participation in various recreational activities; and socioeconomic data about the people participating in these activities.

For a variety of reasons, however, such surveys have involved no systematic approach to the collection of data over time. Therefore, trend analysis has been difficult or impossible. Similarly, at a more local level, recreation use data has been often limited to yearly estimates or counts of participation for individual sites. As a consequence, it has been difficult to determine whether trends developed from this data reflect real demand responses, or supply responses, or a combination of both. Therefore, analysis and planning for outdoor recreation has often not competed effectively with other values such as urban and industrial development, timber harvest programs, and water resource and energy development. National policies and program decisions on these competing outputs will be strengthened by availability of increasingly comprehensive information bases and analytic systems to evaluate future demands. If comprehensive, comparable information is not developed for outdoor recreation, outdoor recreation probably will not receive adequate consideration in the planning process relative to other resource programs. Provision of this information base presents a major challenge to all of us concerned with outdoor recreation.

TRENDS FOR THE 80'S

Factors that influence recreation participation are complex and interrelated, and the complexity is growing. Past experience is no longer useful as a single input to planning. Even the old standby indicators--population growth, leisure time, income, and mobility--are no longer as useful for planning as they once were. These were useful indices when demands for all leisure services were soaring and people were participating in as much recreation as they could. Under these conditions, more was always better, and the planner with the most grandiose plan was usually closest to fulfilling demand.

But tomorrow will be much different. New factors will influence the shape of future demand, and the influence of old standby indicators will change. Energy availability, urbanization, technology and other factors will be of as much or more importance in determining demands in the 80's as the old standby predictors were during the 60's and 70's. These shifts will necessitate a whole new approach to planning, a need to develop new understanding of the factors that influence demand, and a new system for monitoring trends in key indicators that influence demand. Some of the factors that we feel will be important in shaping recreation demand in the 80's are discussed below. They are organized into five categories: Demand Generating Factors; Changing Patterns of Participation; Characteristics and Availability of Supply; Technological Change; and Energy.

DEMAND GENERATING FACTORS

Population characteristics

An obvious determinant of recreation demand is population size. The more people, the greater the demand. In the U.S., the current population is about 221 million and it is expected to grow to an estimated 232-234 million by the year 1985, and to 250-300 million by 2000. But, the population growth rate has decreased sharply in recent years. In the absence of major changes in birth or death rates, this decline in the rate of growth seems likely to continue. Thus, while the total size of the population will continue as an indicator of future demand for recreation, it may not be as important an indicator as it has been in the past.

Rather, population structure will play a bigger role in determining the kinds of recreation activities and experiences demanded. As population structure changes, shifts occur in recreation demand patterns. The age structure of the population provides an example. Past fluctuations in birth rates--decreasing during the depressed 30's, increasing dramatically during the 40's and 50's, and the current sharp decline--have produced age bulges in the population distribution. Because these bulges reoccur periodically through time, social, economic, and other institutional services, including recreation services, will have to be adjusted up and down through dynamic planning. In the longer term, the mean age of the U.S. population will continue to increase due to better health services and reduced birth rates, and demand for physically active forms of outdoor recreation are likely to decrease.

Relationships between work and leisure

A second major demand-related factor that will significantly influence recreation consumption in the 80's is the patterning of work and leisure throughout society. In most industrialized societies, time devoted to work activity has decreased steadily over the past 100 years.

Factors unrelated to work have also added to the growth in available leisure time. Technological innovation has allowed for the more efficient use of time. In the home, techology has reduced time required for subsistence tasks. More efficient transportation systems have significantly reduced travel time, and, as a result, provided more at home leisure time.

Whether or not the trend in available leisure continues upward is the subject of considerable debate. Few comparable studies have been done to determine trends in leisure time. It may very well be that we are approaching a limit to the upward trend in leisure time. In fact, leisure time may actually start to decline because of offsetting trends in increased time needed to commute and additional time shifted to nonrecreational pursuits such as home maintenance and community services. Individual and social attitudes toward use of leisure is also likely to be more important.

Changing social/cultural roles

Another important group of variables that will influence future recreation planning relate to the changing role of individuals in society. While work-leisure patterns influence the frequency of participation, "experiential" factors, such as expectations, satisfactions, and participant attitudes, influence the type of recreation experience demanded.

First among these factors is the changing nature of children's experiences. Childhood experience has been found to influence adult recreation behavior. This is particularly true for major forest-oriented recreation activities like fishing, camping, and hunting. As the trend toward urbanization continues, children growing up in cities may have limited opportunity to engage in leisure activities that depend on natural surroundings. At the same time, they will have more opportunity to learn about alternative forms of leisure activities--activities that do not require natural environments.

A second experiential factor deals with what might be termed perception of aging. While the process of aging involves a decline in outdoor recreation participation, the future rate of this decline may depend on society's perception of the elderly, and, even more, on the way elderly people view themselves. Until the mid-sixties, it was felt that people began to disengage themselves from the mainstream of society after they reached retirement age. But, as the mean age of the population has increased, a new concept has emerged. Older people now maintain a higher level of activity than they did a few years ago. The new emphasis on activity is keeping elderly people more active, while improvements in health care systems help to keep them in better physical condition. The implications for future planning are obvious.

Another facet of the changing role of the individuals during the 80's is the nature of the individual's role as a member of a family. People are marrying later, having fewer children, and many married couples are not having children. Furthermore, married individuals are increasingly pursuing careers independent of their marriage. These trends in marital relationships are drastically altering the role of women in today's society. The changing role of women may have a greater impact on recreation consumption than all other factors combined. Women are now making incursions into heretofore predominantly male recreation activities. -- This trend merits close observation if we are to plan realistically to meet future recreation demand.

Living environments

Throughout the 70's, late on any Friday afternoon, a steady stream of cars could be seen leaving major U.S. cities. The cars returned on Sunday evening after their occupants had experienced a weekend of recreation in the rural countryside. This mass-weekend exodus, although facilitated by cheap fuel, could be attributed in part to a need for temporary escape from the rigors of urban living. The degree to which stress-producing aspects of urban living can be reduced will strongly influence the need to escape cities in the future, and, correspondingly, affect demand for rural recreation. If sheer population density is the cause of urban stress, then there may be no real solution and the weekend migration will continue. But recent studies indicate that crowding alone is not sufficient to produce such stress. If high-density living is not a source of urban stress, then it may be possible to solve some pressing urban problems. If cities of tomorrow can be provided with sufficient amenity values, recreation behavior of urban residents will be altered significantly. Attractive urban environments will reduce demands on rural recreation resources. Conversely, if such urban environments are not modified, demands on rural recreation resources will increase substantially. But, under conditions of energy scarcity, there may be no alternative to revitalizing cities.

Another urban-related factor that will have strong influence on future demand will be the movement away from single-family residences. The trend toward apartment living, condominiums, and multi-unit dwellings is likely to continue as prices continue to increase and developable urban space decreases. As energy scarcity grows, urban areas are likely to reach a geographic limit based on availability of public transportation. There will be little alternative but to move toward more concentrated populations. This movement will mean that backyard space, once available to single-home unit dwellers, will no longer be available nor will easy access to the countryside. The result will be an intensification of demand for recreation facilities in and very near urban centers.

Economic environments

Much of the past growth in outdoor recreation consumption has been fostered by easy access to inexpensive forms of recreation. Not only has participation been relatively inexpensive, incomes have been growing, thereby providing the ability to participate in recreation and purchase consumer items. The relative price of recreation in comparison to prices of other goods and services has been relatively low. Few can argue that at the outset of the 80's, gains in income are often offset by inflation and by the soaring costs for basic necessities--food, housing, clothing, and energy.

As we plan for leisure services during the 80's, we must monitor relationships between markets that most impact on recreation and on relative price relationships. The 80's may demonstrate how really important recreation participation is to the American public--as shown by how willing people are to pay for a higher proportion of costs in relation to other demands on their increasingly scarce financial resources. The same relationships will hold for public expenditures for providing recreation in relation to growing costs for other public services.

CHANGING PATTERNS OF PARTICIPATION

The cumulative effect of rapid change in the factors previously discussed is that recreation behavior patterns will be subject to both short- and long-run change. These changes underscore the need to document, on a continuing basis, the outdoor recreation participation rates and patterns of the population as a whole and for various segments within the population. Only in this way can we begin to identify meaningful trends and shifts in participation and to develop plans that are responsive to changing demand.

Many leisure activities are substitutable, and the individual can freely interchange among them. Similarly, some activities are complementary--as demand for one goes up the demand for others goes down. While there is little known about these relationships, we should recognize that as major factors that underlie recreation behavior change, people will adjust their patterns of leisure behavior through substitution and complementary decisions about the activities they select.

Futhermore, we need to understand motivational determinants of leisure behavior, i.e., forces that underlie recreation behavior patterns and choice. These motivational forces provide a basis for understanding current recreation behavior and may serve as a guide to predict how people are likely to substitute among alternative recreation activities.

CHARACTERISTICS AND AVAILABILITY OF SUPPLY

Supply factors also influence participation patterns. One supply-related factor is the changing pattern of land ownership. Today, most forest land and open space in or near large metropolitan areas is in small tracts held by private owners. These owners have exhibited a growing tendency to restrict public access to their land. The degree to which these privately owned lands can be used for public recreation will depend largely on the public's willingness to reimburse owners for such use. Land zoning, recreational easements, transfer payments, and other land use control devices can be employed to increase the amount of recreation land readily accessible to urban populations. Or, public agencies can purchase these lands. Measures are needed to index the change in distribution and relative accessibility of such resources so that appropriate supply responses can be developed through planning.

Other indices are also needed to evaluate how supply can be altered to meet recreation demands. For example, indices are needed to evaluate how existing facilities can be expanded to their full site capacities, or adapted to the needs of special populations. This information will make it easier to make policy decisions to influence recreation consumption by changing any combination of the following: The quality of recreation experience provided; methods of management; site capacity; and accessibility and availability of recreation facilities. Scarce and unique resources present a special problem. Here, use must be closely monitored in relation to site capability so that plans can be made to control and regulate use within resource capabilities.

Finally, it will not be sufficient to know where supply exists and to understand its changing capability without understanding how accessible it is to various population segments. What is accessible to an urban slum resident is not the same as what is accessible to an upper middle class person living in an adjoining neighborhood. Supply-related trend indicators, therefore, need to be evaluated in terms of their relationship to various population segments before such indices can be made useful for planning decisions.

TECHNOLOGICAL CHANGE

By introducing new types of recreation equipment, technology provides a continual change in the composition of available leisure activities. For example, the recent development of electronic games has provided new forms of home-oriented indoor leisure pursuits. Development of snowmobiles and other recreational vehicles has created demands on outdoor recreation resources that were not even dreamed of when plans for recreation facilities that serve these activities were developed. Estimates of the impact of technology on recreation demand can only be very roughly estimated, but it is certain that technology, both directly related to providing new kinds of leisure pursuits and to factors that influence recreation demand, will shape the future of recreation behavior. The impact of technology on planning is obvious. Systems need to be set up to monitor technology and to evaluate the kinds of impacts that are likely to occur.

ENERGY

We conclude this review of major factors that need to be monitored with a discussion of the factor that has had as much impact on starting the surge in demand for recreation as anything else--Energy. Few would argue that availability of inexpensive energy, coupled with correlated improvements in transportation methods and systems, contributed greatly to past growth in recreation consumption. Once it was believed that this abundance would continue; but as gasoline lines grow and prices skyrocket, the future seems much less predictable.

If energy costs remain low or if technology creates ways for more efficient uses of available energy, current rates of recreation consumption can be sustained. But, if these things do not occur, major shifts in recreation demand patterns are likely to occur. For example, during the recent gasoline shortage, U.S. recreation travel patterns changed significantly. As gasoline becomes more scarce and costly, people will have to make choices about how they will either allocate scarce gasoline (if rationing occurs) or how they will allocate income (if gasoline prices continue to rise) among competing needs. How recreation fares in these decisions will have a big impact on recreation demand. These decisions must be of central concern to recreation planners.

SUMMARY AND CONCLUSIONS

In this paper, we have briefly reviewed the planning process in relation to the kinds of trend data that will be needed to plan for future recreation needs. We have identified some of the kinds of trend indices that we feel will be important in the future and tried to indicate why we feel they will be important. We have not, however, addressed how data on these indices should be collected; nor have we commented on the research needed to determine relationships between trend indications and future demands; nor have we discussed the development of modeling techniques needed to make demand projections and assessments. Hopefully these will be major topics for consideration during this conference.

The best of all possible situations would be to design a monitoring system to track all trend indices needed for planning. Of course, this is not feasible because it would be inefficient and impractical. There remains a great deal of work to do to: Determine which indices are most important; determine the way in which the various factors influence recreation behavior; relate indices to the planning process; design systems to monitor indices; and develop models to evaluate alternative plans.

We have tried to show that as the 70's differed from the 60's, the 80's will bring new changes that will influence recreation consumption and, consequently, recreation planning. Among these factors are inflation, energy, transportation systems, international relations, urbanization, etc. All of these factors will have impacts on shifting and changing the shape of demand for recreation. The old indices will not work. For example, we can be sure that population will increase, but, unless people have access to inexpensive gasoline, disposable income, and recreation facilities, they will not be able to participate in recreation. Shifts in factors that influence recreation behavior will necessitate a whole new approach to planning based on a revised understanding of the factors that influence demand and a new system for monitoring trends in key indicators.

The Growth of Selected Leisure Industries[1]

Elizabeth R. Owen[2]

Rapidly rising sales of sporting equipment, as well as the phenomenal growth of receipts from a variety of recreation-oriented service industries, have contributed in establishing the recreation market as one of the most dynamic and fastest expanding sectors of the United States economy.

Please see the full Commerce report for a greater, in-depth treatment of the subject material. Tennis, boating, camping and skiing are treated in four individual chapters. Detailed tables on expenditures, rates of participation, etc., are also included.

OVERVIEW OF LEISURE INDUSTRIES

Expenditures on leisure activities, especially outdoor recreation, represent a major and growing segment of the American economy, having reached $81.2 billion in 1977, $20 billion more than in 1974. This spending represents 7 percent of total personal consumption expenditures and covers outlays for a multitude of leisure pursuits ranging from admission to movies and sporting events, to magazine and newspaper subscriptions, and to purchases of toys and sports equipment.

The $81.2 billion does not include such expenditures as transportation and lodging connected with pleasure travel, vacation homes, and public recreation. When these and other related activities are added, the combined total is much higher and although precise amounts are not available, one recent estimate put the grand total of leisure spending in 1977 at $160 billion.

A rough estimate of the major components of leisure activity breaks down the $160 billion total spent on leisure into:

> $27 billion for sporting goods purchases and associated service expenses.
>
> $58 billion for television sets, radios, records, musical instruments, reading material, admissions to sports events, movies, cultural events, clubs and fraternal organizations, gardening materials, and other personal consumption expenses such as pets, photography, etc.
>
> $71 billion for vacation travel, both domestic and foreign.
>
> $4 billion for vacation cottages, second homes, vacation lots.

The volume of retail sales generated by the demand for sports equipment is shown in table 2 which presents the 10 most popular categories in 1976, the last year ranking was available.

Sport equipment categories that are expected to have the greatest growth potential in the years ahead are soccer, racquetball, skiing, fishing, camping, softball, tennis, exercise equipment, sports apparel, and jogging shoes. Women's team sports equipment and apparel should also generate sales in the near future.

---

[1] Paper extracted from The Growth of Selected Leisure Industries, U.S. Department of Commerce, May 1979. Available from U.S. Government Printing Office, Wash., D.C. Stock No. 003-009-00319-9. 41 pages.

[2] Recreation Analyst, Heritage Conservation and Recreation Service, U.S. Department of the Interior, Wash., D.C.

Table 2.-Retail Sales of Sporting Goods
(millions of dollars)

Category	Sales in 1976	Percentage Change 1975-1976
Recreation vehicles - - - - -	$2,700	16
Pleasure boats, motors and accessories - - - - - -	2,370	15
Firearms and hunting supplies - - - - - - - - -	1,120	5
Bicycles and supplies - - - -	957	12
Athletic equipment - team sales - - - - - - - - - - -	719	7
Tennis equipment - - - - - -	666	20
Golf equipment - - - - - - -	587	6
Fishing equipment - - - - - -	506	8
Snow skiing - - - - - - - - -	421	11
Camping - - - - - - - - - - -	386	7

Source: National Sporting Goods Association.

Product sales tell only part of the leisure story. Another part, probably the most dynamic one, is the services aspect of the recreation industry. For example, for skiers there are lift tickets to buy, for tennis players there are court fees, and for scuba divers there is the cost of refilling their tanks with oxygen. Other service activities would include equipment repair shops, facilities construction, management consulting firms, and professional sports instruction. These services are expanding more than the manufacturing sector, and will eventually form the heart of the leisure industry.

Further evidence of the magnitude and growth of leisure activities is attendance at major professional sporting events, which increased more than 45 percent between 1966 and 1976, as spending at these events almost tripled, from $668 million in 1966 to $1.5 billion in 1976.

More Time and Money for Leisure

The two major factors that have encouraged the explosive development of recreational markets have been time and money. In the past two decades, Americans have seen almost steady improvement in the amount of their time and money available for leisure pursuits.

While the 40-hour work week has remained constant since the end of World War II, the average worker now gets longer vacations and more holidays. This means that the average "leisure year" is 122 days--one-third of the total year. The expanded leisure year offers significant opportunities for outdoor recreation--fifty 2-day week-ends, a vacation period averaging 16 days, and at least five 3-day weekends associated with Monday national holidays. Leisure time is not expected to change to any great extent in the 1980's. While any decrease in total working hours is likely to be minimal, it is probable that further gains will be made in obtaining longer blocks of leisure time by reshuffling working time through such innovations as the 4-day work week and flexitime.

On the money side, real per capita disposable income (personal income adjusted for inflation and taxes) has been climbing steadily over the years, a fact that has contributed to the rise in discretionary income (money available for spending on items other than basic necessities). As a result, the long-term trend in recreation spending as a percentage of personal consumption expenditures grew from 5.5 percent in 1960 to 6.8 in 1975. This upward trend has leveled off slightly in recent years, mainly because of inflation which takes a larger share of personal income to cover the higher costs of housing, food, utilities, and medical care.

Spectator and Participatory Sports

Both spectator and participatory sports are contributing to the outdoor recreation boom. Professional sports leagues now operate nationwide in baseball, football, ice hockey, basketball, soccer, volleyball, softball and tennis. Since 1965, the number of major-league teams in all professional sports has jumped from 57 to close to 200. Additionally, touring golf, bowling, and tennis professionals criss-cross the country the year round for weekly tournaments.

Professional sports are thought to be still in the growth stage--with good opportunities for further expansion, particularly internationally. More and more U.S. teams will be playing in other countries in the near future, and the possibility of pay television is expected to have positive impact on pro sports. The major TV networks are increasing their sports coverage markedly, a fact that contributed tremendously to stimulation of interest. Spectator attendance at the 18 most popular major sporting events increased from 217 million in 1966 to 314 million in 1976.

The enormous growth in participatory sports has been even greater than that for spectator sports. There has been a greater popularization of sports activity among all classes and ages. Tennis, sailing, and squash were once the sports of the rich. Bicycling and rope jumping were formerly limited mostly to children. Camping, jogging and weight training were once considered only the idiosyncrasies of nature and physical fitness aficionados. All these sterotypes have disappeared now.

The recent surge in sports participation is the result of years of publicity about the benefits of exercise and better nutrition. Starting in 1975, American deaths from cardiovascular disease fell for the first time in a decade. New figures show that the mortality rate from heart ailments, long known as the epidemic disease of this century, has declined by more than 30 percent since 1950.

So popular has exercising become, that there are now an estimated 3,000 health clubs and spas around the country with several million members. The benefits of exercise also are being increasingly recognized by private industry which loses each year an estimated 52 million workdays to heart disease and $1 billion to common backaches. Many businesses are providing facilities and organized physical fitness programs for their employees, varying from a single softball field to million dollar exercise facilities run by professional staffs.

This increased interest in physical fitness and its physiological payoffs do not appear to be spread equally among the population. Results of studies indicate that most of the exercising is being done by the young, the better educated, and the affluent, by men more than women, and mostly by those in the Northeast and Far West.

Manufacturing, Distribution, and Employment

Scarcity of market data and occasional over-estimation of demand are partly rooted in the structure of the industries providing sporting goods and equipment. At the manufacturing level, only a few firms qualify as "powerhouses," with thousands more small firms in existence. Additionally, there are many small manufacturers who drop-ship directly to dealers, avoiding the traditional wholesale distribution system. This direct factory-to-dealer relationship is more extensive in the sporting goods industry than in most other consumer goods lines. Only the firearms and fishing tackle industries have substantially organized wholesale distribution.

Because of a lack of truly national sporting goods chains, the retail sporting goods industry is as fragmented as the manufacturing side. If more national chains existed, more standardization of products would probably occur, although favorable customer reaction to fewer, more standardized products in sports is somewhat doubtful since players seem to demand higher quality and more customized equipment as they become more skilled in their sports.

Following the trend of many other retail operations, the size of sporting goods stores in the future will tend to be either small and very specialized, or very large and general. Large stores, many of which are discount operations, are expected to increase their share of the total market from 15 to 25 percent by the mid-1980's, and will become involved in the service end of sports, such as repairing the equipment they sell, renting equipment, offering lessons, or sponsoring clinics or trips.

A more specialized, but growing aspect of sporting goods retailing is mail order sales of sporting goods and recreation equipment. Reflecting a growing belief that mail order purchasing is a more convenient and more budget-conscious way to buy, sales for 1975 are estimated to be about $113 million. Some acquisitive interest on the part of a number of conglomerates has also been reported in recent years.

Full-time and part-time employment opportunities in recreation are plentiful and are expanding rapidly. For instance, there is a growing demand for professional sports instruction, with tennis as the best example of this trend. Additionally, professional opportunities exist in sales and management of retail operations, management and maintenance of sports facilities, equipment repair, and consulting services for the development and management of sport facilities and sports programs.

Private sector employment opportunities are expanding and appear to offer the greatest potential. The U.S. Department of Labor in its Occupational Outlook Handbook predicts good employment opportunities in recreation in the 1980's. Estimates are that the private sector provides approximately 5 million jobs in recreation or leisure industries.

Public sector employment is smaller but still significant. An estimated 80,000 to 85,000 people are employed in Federal, state and municipal public recreation programs. These jobs are with parks, campgrounds, swimming pools and beaches, ski areas, arts and crafts programs, tennis facilities, and urban playground and recreation program centers. All of these activities require managers, planners, instructors, and maintenance professionals.

Various development assistance agencies, such as the Small Business Administration, the Economic Development Administration of the U.S. Department of Commerce, and the U.S. Department of Labor under the Comprehensive Employment and Training Act, are including construction of recreation facilities among their grants to stimulate employment. Some examples of where this funding is going are: a multi-million dollar grant for the refurbishing and building of sports facilities for 1980 Winter Olympics which will be held at Lake Placid, New York; construction of a freshwater lake/reservoir in Illinois also including designs for multiple recreation use; and grants to various localities for the construction of tennis courts, inner city recreation centers, and bicycle trails over abandoned railroad track beds.

Recreation and Travel

Few industries have as many areas of mutual interest and benefit as the recreation and travel industries. In effect, many recreation activities could not occur without the services of the travel industry. Conversely, a good portion of the travel industry is totally recreation-oriented, such as resort hotels, destination resorts, and ocean cruises. Resorts and carriers provide the means and destination activities that induce people to travel and attract them to a particular place, while the manufacturers of leisure-time products provide the tools of play.

A further benefit that results from this symbiotic relationship is the removal of the "fad" aspect from sports. Patronage of a resort for a particular sport in effect institutionalizes that sport. Permanent facilities--ski slopes, golf courses, tennis courts, marinas, bike paths, and pro shops--induce return business. Organized participation practically guarantees not only repeat equipment buyers, but also repeat resort customers.

The love affair with the "active life" has brought a radical attitudinal change to many Americans' approach to leisure. Leisure time has become just as important to them as their work lives. As with their careers, they are frequently setting goals for their leisure time, such as becoming a ranked tennis player, getting rid of a slice in their golf game, or training for the Boston Marathon running classic. In addition, more people are taking vacations with an athletic purpose. For example, in 1975 some 12 million people played golf, tennis, or skied while on vacation or in the course of taking trips. Of these 12 million, half took a trip for the primary purpose of engaging in one of these sports. Added to this group are uncounted millions who took a trip for the purpose of fishing, boating and other water sports. Assumptions are that vacations or trips whose primary purpose is to take part in a sport will increase in the future.

Tremendous opportunity for growth for the hotel/motel industry exists in the pleasure travel market. Many operators are beginning to add to their properties such features as athletic and health club facilities, tennis and handball courts, saunas, and tie-in arrangements with nearby golf courses or ski areas.

Package plans that cover lodging costs and sports admission fees or equipment rentals for one price are becoming extremely popular. Properties that are located in winter ski areas or include golf course, tennis court or horseback riding facilities have been the most extensive users of such package plans.

Other factors have encouraged businesses to concentrate marketing efforts on the pleasure travel market. The introduction of new, more economical types of air charters in the mid-1970's, the elimination by the Civil Aeronautics Board of many restrictive regulations on air charters, and the CAB's easing of discount air fares have also stimulated consumer interest in travel. The seemingly unending boom in U.S. travel by Americans and foreigners will undoubtly further stimulate new and existing recreation markets, while the travel and leisure industries will cooperate more with area retailers in joint promotion, such as packaged sports tours, resort programs of sports' instruction, and hotel sponsored weekend skill workshops.

Women's Involvement

Sales of almost all types of recreational goods and services to women are an area of both current growth and future potential. Women of all ages and all socio-economic levels are taking up a variety of sports, many for the first time. For example, more women are playing tennis now; one survey by the National Tennis Foundation reported an estimated increase of 50 percent from 1973 to 1974. A survey conducted by the National Federation of State High School Associations showed considerable increases in the number of girls participating in inter-school golf, skiing and tennis competition, which is a sharp reversal from the situation existing just a few years ago. Then not only inter-school female team competition, but any female athletic program, was the exception rather than the rule.

One major factor adding to growth in women's sports participation at high school and college levels has been Title IX of the Education Amendments of 1972. Under Title IX, schools receiving any form of Federal financial assistance must make athletic equipment, facilities, and opportunities equally available to both sexes. Since the athletic budget for women at the collegiate level was only 2 percent of the men's budget in 1975, a tremendous potential market for sporting equipment, footwear, apparel, and services specifically designed for women exists. In addition to the growth of the women's school athletic market, possibilities for a large increase in the number of women's athletic teams in industrial or high school teams.

While in their infancy women's professional sports are enjoying a healthy and rapid growth. Women professionals in golf and tennis are competing for purses in the hundreds of thousands of dollars, up from just a few thousand dollars in the most recent years past. Other sports that are fielding women professionals and pro teams are skiing, softball, volleyball and basketball. Many industry observers feel that women's professional basketball will develop into a major spectator sport in the next few years.

By far the greater increase in women's sport participation has been on the individual level. Apart from tennis that has enjoyed the greatest growth in popularity among women, a 1976 Nielsen survey indicated that 21 million American women participate in fishing, up from 9 million in 1970, slightly over one and one-half million women go in for hunting, up from 869,000 in 1970, and 20 percent of the Nation's scuba divers are women, up from 5 percent in 1970. There are now several fishing, hunting, and outdoor groups specifically organized for women's membership; these groups have helped promote interest among women in these traditionally male-dominated sports.

This positive projection of the women's market for recreational goods and services is underscored by current trends in the employment and income levels of women. For the first time in history, a majority of women between 18 and 64 are employed, and demographers feel that this percentage will increase from the present 52 percent to 65 percent in 1987. Female purchasing power is also increasing not only in terms of the number of women who earn independent incomes but in their wage and salary levels as well. These economic factors greatly enhance the potential of the women's side of the leisure market.

Future Developments

The surge in the young adult population which will continue for the next few years is favorable for most segments of the recreation industry, especially for those selling equipment for active sports and outdoor activities. Headed by men and women of ages 25 to 34, this group is more than 50 percent larger than a decade ago and should increase by another 35 percent over the next decade. But even in the areas of less active sports, greater longevity, improved health care, and increasing numbers of people on adequate retirement plans strongly suggest a sturdy market for the relatively less strenuous type of activity.

Another favorable demographic factor affecting recreation industries is the geographic movement of population. Already a definite shift of the U.S. population to the South and to the West has occurred. During the next decade, the South is expected to increase its population by 20 percent, the Mountain States by 24 percent, the Southwest by 25 percent and the West by 18 percent, while at the same time large population centers in the East and Midwest will decline.

To understand the factors that have contributed to boom times for the recreation industry in general and for outdoor sports in particular, please see my full study. The sections on tennis, camping, boating, and skiing will analyze their current market performance and try to project their future growth.

TRENDS IN FINANCING AND AVAILABILITY OF CAPITAL[1]

Donald G. Schink[2]

Abstract.--The past, present and future of recreation enterprise financing is developed in this paper. Developers need to utilize all available methods of financing sound projects. The long-term solution to the problems depend on better information, improved educational programs, and a loan program tailored to the needs of this industry.

HISTORICAL PERSPECTIVE

Early travelers utilized small hotels, roadside cabins, restuarants, taverns and other service facilities for their needs. They often camped at the side of the road. Sportsmen generally felt that all public and private land was available to them for hunting and fishing.

The resort industry in many states got its start as hunting and fishing camps. These consisted of crude cabins with outdoor plumbing and a row boat.

From these beginnings, the recreation-tourism industry gradually evolved into what we know today. Included are resorts that cater to visitors during all four seasons, attractions that provide entertainment to large numbers of people, motels, restaurants, golf courses, ski hills, and all of the support enterprises.

The commercial recreation sector has been enhanced by the development of many national, state, county and city parks and recreation programs.

Recreation enterprises have generally been small, family owned businesses, often located in remote locations. They often have been under financed and having managers with little training or experience. The recreation industry is plagued with short seasons, unpredictable weather, government regulations and governmental competition.

In 1965, we held a public policy forum in Fifield, Wisconsin on the topic of "Financing for the Recreation Industry." It was attended by leaders from local government, the resort industry and bankers. The meeting was called because of the problem of securing loans to upgrade and expand resorts and other recreational enterprises. It was the conclusion of the leaders attending that:

1. There was a need for educational programs to improve the management of enterprises.

2. New governmental programs were needed to provide long term loans to recreational enterprises.

It would be interesting to repeat the Fifield conference of northern Wisconsin leaders at this time. Their recommendations might be about the same in 1980 as they were in 1965. Our basic problems remain.

The cost of capital has varied somewhat over the years but always seems to gradually increase. During the 50's and early 60's, interest rates for commercial loans were in the 5 to 6 percent range. From the mid 60's through the mid 70's the interest rates generally increased to the 8 to 9 percent range. In the late 70's, we saw a rapid escalation of interest rates with prime interest rates reaching as high as 15.5 percent.

Recent higher interest rates have been accompanied by shortages in the money market. Only the most profitable enterprises receive loans in times of high interest rates and tight money supplies. Recreation enterprises with their traditional low profitability end up on the bottom of the priority list.

---

[1] Paper presented at the National Outdoor Recreation Trends Symposium, Durham NH, April 20-23, 1980

[2] Recreation Business Specialist & Director, Recreation Resources Center, University of Wisconsin-Extension, 1815 University Ave. Madison, Wisconsin 53706.

Most financial discussions center around the availability of mortgage loans needed to finance recreation developments. We are also concerned with the amount of equity that must be invested by the owner/developer. In many cases this limits the size of projects that can be developed and contributes to the project's security.

ANALYSIS OF LENDING SOURCES

Commercial recreation enterprises have relatively few sources of mortgage financing for new or expanded businesses. They generally are banks, the Small Business Administration and the Farmer's Home Administration. In some instances, the Economic Development Administration has provided mortgage funds.

Banks

The prime sources of funding for small businesses has been their local banks. They have the capability of making loans on the real estate, equipment, and operating capital. Banks generally have lending limitations to individual borrowers of approximately 20 percent of their capital and reserves. They also have a total lending limitation. Innovative bankers have provided mortgage dollars to clients by utilizing correspondent banks, by syndicating loans with other lenders and by utilizing SBA or FmHA guarantees.

Small Business Administration (SBA)

The SBA was established by Congress to aid, counsel and protect the interest of small business concerns in order to preserve the nation's free enterprise system. SBA provides loans or loan guarantees for land, buildings, equipment, inventory and working capital. Generally, money is provided by a participating bank with SBA guaranteeing up to 90 percent of the loan. Loans do not exceed $350,000.

The scope of the SBA loan program in 1976 was provided in a paper prepared by Dr. Malcolm Bevins (Table 1). Similar information for 1977, 1978 and 1979 was provided directly by SBA.

[illegible]

INDUSTRY DESCRIPTION	NUMBER OF LOANS			
	1976	1977	1978	1979
Eating Places	[illegible]	2,620	2,739	2,668
Hotels, Motels and Tourist Courts	238	286	344	274
Gasoline Service Stations	[illegible]	587	557	565
Drinking Places	286	306	318	275
Miscellaneous Recreation & Amusement	132	201	223	200
Sporting Goods and Bicycle Shops	[illegible]	367	331	306
Aircraft, Go-Cart, Motorcycle Dealers		119	101	96
Gift, Souvenir, Novelty Shops	[illegible]	224	265	223
Boat Dealers	53	80	[illegible]	70
Sporting and Athletic Goods Mfg.		53	41	51
Trailer Parks and Campsites	[illegible]	52	[illegible]	46
Trailer and Mobile Dwelling Mfg.		12	12	[illegible]
Camera and Photo Supply Store	[illegible]	[illegible]	48	49
Boat Building and Repairing	[illegible]	46	[illegible]	46
Arrangements for Transport	[illegible]	28	41	60
Sporting and Recreation	20	20	20	[illegible]
Public Golf Courses	7	21	17	11
Small Arms Mfg.		6	[illegible]	1

Source: Mr. Richard P. Lewis, Director, Reports Management Division, Small Business Administration, Washington, D.C., [illegible], 1980.

Table 1 (con'd).--SBA Loan Approvals (Total U.S.)

INDUSTRY DESCRIPTION	VALUE OF LOANS (in Millions)			
	1976	1977	1978	1979
Eating Places	[illegible]	$244.8	$292.5	$311.1
Hotels, Motels and Tourist Courts	$ 36	[illegible]	$ 74.7	$ 61.3
Gasoline Service Stations	$ 24	$ 33.3	[illegible]	$ 31.7
Drinking Places	[illegible]	$ 23.1	$ 24.3	$ 26.0
Miscellaneous Recreation & Amusement	[illegible]	$ 30.6	$ 29.7	$ 31.5
Sporting Goods and Bicycle Shops	$ 16	$ 22.1	$ 21.2	$ 25.9
Aircraft, Go-Cart, Motorcycle Dealers		$ 9.6	$ 8.5	$ 8.4
Gift, Souvenir, Novelty Shops	[illegible]	[illegible]	$ 12.1	$ 12.3
Boat Dealers	[illegible]	[illegible]	$ 7.3	$ 6.8
Sporting and Athletic Goods Mfg.		[illegible]	$ 6.8	$ 9.0
Trailer Parks and Campsites	[illegible]	[illegible]	$ 10.0	$ 7.8
Trailer and Mobile Dwelling Mfg.		[illegible]	$ 2.3	$ 1.6
Camera and Photo Supply Store		[illegible]	$ 3.0	[illegible]
Boat Building and Repairing	[illegible]	$ 5.8	$ 6.0	$ 6.2
Arrangements for Transport	[illegible]	[illegible]	$ 1.5	[illegible]
Sporting and Recreation	[illegible]	[illegible]	$ 2.4	$ 1.3
Public Golf Courses	[illegible]	4.4	$ 3.7	$ 1.7
Small Arms Mfg.	[illegible]	$ 1.1	0.5	$ 0.1

Source: Mr. Richard P. Lewis, Director, Reports Management Division, Small Business Administration, Washington, D.C., Feb. 6, 1980.

Farmer's Home Administration

The Farmer's Home Administration of the U.S. Department of Agriculture has the authority to make loans for outdoor recreation. They make loans under 1) Business and Industry, 2) Recreation Facility loans to farmers and 3) Community and Non-Profit Loans program. Commercial recreation enterprises can apply for Business and Industry loans. Under this program, the FmHA would guarantee up to 90 percent of the loan. Generally, FmHA makes loans of over $350,000. They cannot make loans in or near metropolitan areas (over 50,000 population).

Dr. Bevins reported the number and amount of loans made for recreation in 1972 and 1976, they are listed in Table 2.

[illegible] Sector (Total U.S.) by the Farmers Home Administration, USDA, 1972 and 1976.

PROGRAM	NUMBER OF LOANS		AMOUNT OF LOANS	
	1972	1976	1972	1976
Business & Industry (Recreation Loan Guarantee)	0	[illegible]	[illegible]	$37,858,028
Recreation Facility Loans to Farmers	48	38	$1,807,820	1,772,090
Community & Nonprofit Loan Program	[illegible]	17	N/A	3,800,000

Source: Data supplied by Farmers Home Administration, August, 1977.

In comparison, Wisconsin's FmHA loans for recreation during the past five years is as follows:

	# Loans	Total Loaned
Nonprofit Corporation	2	$ 96,000
Municipality	1	340,000
Individual Recreation (Farmers)	96	2,789,000
Profit Corporations (Guaranteed)	7	8,193,000

Economic Development Administration

The EDA has authority to make loans for recreation enterprises in EDA designated areas. These generally are areas of high unemployment. However, most of their dollars are allocated to public works projects. It is difficult for commercial recreation enterprises to qualify for EDA funding because most are not labor intensive.

INNOVATIVE APPROACHES TO FINANCING RECREATION PROJECTS

We are in an era of tight money, fluctuating interest rates (generally higher), soaring construction costs, and shifting markets. Yet there are recreation projects that need to be built, and enterprises that should expand. Financial advisors will need to help prospective businesspersons, and developers utilize the financial tools available to them. Following is a review of some of the finance systems used by financial managers.

Industrial Revenue Bonds

Many states have a program to assist new industries to get started in the communities. Generally the municipality will authorize a municiple revenue bond issue so that they can be sold to investors as tax-free municiple bonds. However, in most cases the local municipality does not guarantee the bonds. The bonds are sold to banks, individual investors or mutual funds. The advantage is that new mortgage dollars are brought into the community and the borrower has a favorable interest rate. The bond rating is based on the individual project and the developer.

In some states, outdoor recreation and tourism related developments are eligible to utilize the industrial revenue bonding program. In other states, they are excluded or there are limitations on its use. New or amended legislation may be required in several states to make this program applicable to the recreation enterprise.

Tax Incremental Financing (TIF)

A new program for Wisconsin, Minnesota, Iowa, California, Oregon and perhaps other states is the utilization of Tax Incremental Financing to assist new developments. It has been used initially to revitalize blighted areas, but has potential use for some recreation developments. Basically in the Tax Incremental District (TID) created, the municipality uses taxes accruing from the increased value of the property in the district to amortize loans used for all or part of the improvements. It has financed land write-down, cost of providing city services, and in some cases construction costs. This program would seem to have the most potential in urban areas but with some application in the more rural communities.

Joint Venture Capital

A joint venture is generally when two or more parties gamble together on the success or failure of an investment. In the past, it has been a group of two or more investing a combination of land resource, expertise and equity to secure traditional mortgage financing to build a business. Many of the mortgage bankers and insurance companies now want to be included as a limited or full partner in the business. The advantage to the developer comes in the early years because she/he is not locked into rigid debt service payments. Each investor receives a percentage of the profits. The advantage to the lender comes in the form of early years tax credits and losses, a share of the appreciating value of the business and a continuing share of business profits. A joint venture in and of itself does not create any legal relationship between the parties. This is done through formation of a corporation or a limited or general partnership.

Limited Partnerships

A limited partnership is a legal business entity that provides a vehicle for developers to put together equity from several investors. In this arrangement, there is a general partner who provides all of the management with/without some equity dollars and a number of limited partners providing most of the equity investment. The limited partners offset profits, losses and tax credits of the partnership directly against other income. Limited partner investors generally have financial exposure only to the extent of their investment provided they do not enter into the management. They trade the right to participate in Management decisions for the security of limited exposure.

Condominium Financing

Some recreation related projects are financed by the user. This is usually done through the condominium vehicle. In this development strategy, apartments, campsites, boat slips, etc. are sold to the recreational user. In some cases, purchases are made by investors with the prospect of rental income. In condominium projects the developer/manager does not have the burden of capital costs to amortize out of operating income. This type of development was observed first in areas of high recreation demand and generally high land costs. There were condominium apartments and/or town houses on the ocean front in Florida and in the ski resorts of Colorado, condominium campgrounds in California and Michigan and condominium marinas on the Great Lakes. A variation of the theme is the use of Interval Time Share Condominium Sales. In this scenario, users purchase the use of the condominium unit for a specific period. For example, a user might purchase the use of the condominium for the first two weeks in July and would have the use of it every year during this period.

Stock Corporations

Equity capital can be accumulated for recreation developments through the sale of stock to investors. This allows for larger scale enterprises than might be possible by an individual with limited resources. It also spreads the investment risk to a number of individuals. Stock sale is used by both profit and nonprofit corporations.

The nonprofit corporation is a popular way of financing and operating many outdoor recreation enterprises. Most notable are golf and country clubs, hunting and fishing clubs, swimming clubs and tennis or racketball clubs. In this mode of development, the users are the owners and fees are set to cover costs of operation.

Public/Private Coorperative Ventures

A combination of public/private investments have been used in a limited degree in the past. Generally, it occurs when state or federal parks lease land or provide land for recreation development. Examples are the western ski areas where the ski slopes and trails are generally part of the National Forest and resorts and campgrounds leased to private operators by the U.S. Park Service.

Many rural communities with limited population will need to be innovative and get cooperation from all possible sources if they hope to provide the recreational opportunities enjoyed by more metropolitan areas. Think for a moment about the swimming club (nonprofit) and the high school that joined forces to build an indoor swimming pool in Madison, Wisconsin. This same concept could be used by smaller communities for a number of activities needing expensive facilities.

For example, an indoor tennis club requires 100 players (members) per court to have a profitable club. However, if the local school system needs additional physical education space and the facility were located properly it could be used by the school during the day. The tennis club could use the facility during the late afternoon and evening hours. Each would have the use of the facility during their prime time. By cooperating in a venture, small communities could provide more recreational opportunities to their people.

LONG TERM SOLUTIONS

The problems of financing and the availability of capital are not unique to the field of recreation. Over the years we have observed all other sectors experiencing similar problems and to some degree solving their financial problems.

The recreation sector has its special problems. They relate to the seasonality of many recreation businesses, low level of managerial abilities in many small businesses and generally low profits in the industry. The state of the economy and the fuel situation creates additional uncertainties.

Research Information

If the recreation sector is to compete for scarce equity and mortgage dollars, we must have the necessary tools. Information (facts) on the recreation sector is often sadly lacking. Without this information, it is difficult to prove the feasibility of new or expanded enterprises.

If we are to secure financing, researchers need to provide current, reliable information related to:

1. Supply of recreation facilities.
2. User studies giving profiles, demands, trends and expenditures.
3. Threshold studies showing the number of people required to support specific enterprises.

4. Investment costs for each type of recreation development.

5. Impact and costs of recreation/visitor spending.

6. Typical operating statements (standards) for the several recreation enterprises.

Education

Critical to the solution of financing problems is the delivery of research and information to decision-makers. This function is being carried out to varying degrees in the several states by University Extension Programs, the Vocational-Technical schools, colleges and universities and by individual consultants. One of the larger educational efforts in recreation is in University of Wisconsin-Extension. In Wisconsin a team of nine specialists (7.2 FTE) at the Recreation Resources Center work with some 50 county and area agents to provide research and information to recreation managers through workshops and individual assistance.

Information more than anything else will help solve our finance problems. This current, reliable information must be in the hands of the owner/manager/developer of recreation facilities. It must also be understood by the lenders. A knowledgeable developer dealing with an informed lender has the best chance of success.

Local people in a community often do not participate in the financial transaction. However, their understanding and support of projects can be critical to the projects success. We need to provide information on the benefits and the costs to the community of new or expanded enterprises.

Legislation

The recreation sector has long argued for financing programs that are tailored to meet their needs. Features desired would be:

1. Long term mortgates.

2. Modest equity requirement.

3. Fair interest rates (comparable to other good investments).

4. Repayment schedules designed to correspond with peak income months.

5. An agency that is informed and knowledgeable regarding recreation.

6. A minimum of paperwork.

7. Decisions in a reasonably short time.

8. A recreation sector program that will not need to compete with manufacturing, agriculture, retail and other service businesses for available financing.

TRENDS IN PRIVATE AND COMMERCIAL RECREATION

1979[1]

Arlin F. Epperson[2]

Although there has been substantial growth in the supply of outdoor recreation resources, there is no existing system or program to track annual changes in private and commercial facilities or enterprises.

This paper traces efforts to assess the supply of private recreation resources and provides the reader with information on where to look for data on the private sector.

INTRODUCTION

Few serious students of trends in recreation would not agree that recreation has increased in the recent past by almost any measure. The problem has been to accurately assess the amount of the increases.

One of the problems in these assessment efforts has been inconsistent definition of measures. For purposes of this paper "Demand" will be defined as the amount of participation, as measured by visitor days, participation days, contact days, activity days, or the dollars spent on recreation and leisure pursuits. "Supply" will be used to categorize the number of facilities, number of acres, or other measures of the physical facilities themselves rather than those who use them.

Several previous efforts to measure demand and supply are worthy of mention.

ORRRC REPORT

The first nationally recognized efforts to assess the demand and supply of private and commercial recreation was the Outdoor Recreation Resources Review Commission's report, "Outdoor Recreation for America," Volumes 1-27, published by the Federal Government in 1962. One entire volume "The Private Sector Study of Outdoor Recreation Enterprises" was given to the demand and supply of private and commercial recreation.

In reporting demand, the Private Sector study found that recreation areas and facilities provided by private individuals, nonprofit organizations, and businesses attracted some two billion visits annually. Three-fifths of these visits were made to commercial profit making enterprises.

While this early study of recreation participation by 17,342 households in 1960, and later followed up by personal interview surveys of 4,029 randomly selected households in 1972 have been the most widely used and quoted resource information in the recreation and park field, it may now be outdated as more sophisticated and accurate data have been accumulated by such private organizations as A.C. Nielsen studies, which will be discussed later.

Another assessment of private outdoor recreation enterprises was done for the Bureau of Outdoor Recreation in 1965, covering privately owned and operated enterprises in the continental United States which were in existence in the summer of 1965 (Chilton 1966). The inventory was assessed on the basis of a stratified random sample by counties and geographic locations within counties. Outdoor recreation enterprises were identified in pre-selected portions of randomly selected counties and total sample size of 2,102 was investigated. Facilities offering the following activities were inventoried: bicycling; boating and boat rentals; camping -- for instance tent, trailer, group residence, and day; caves; drama and concerts; drive-in movies; driving and sightseeing; lodging; mountain climbing; nature study; picnicking; shooting ranges; skiing -- water and snow; field trails; fishing, salt, cold and warm fresh water; golf; hiking and walking; horseback riding; hunting -- big and small game and waterfowl; ice skating; spectator sports; sports and play fields -- such as archery, tennis or softball; swimming beaches and pools; vacation farms; winter sports.

---

[1] Paper presented at the National Outdoor Recreation Trends Symposium, Durham NH, April 20-23, 1980.

[2] Former Director, Missouri State Parks Jefferson City, MO

Because of the small sample size such an assessment can only be an estimate and can vary as much as 7000 enterprises (one standard deviation of sampling tolerance) in the total numbers projected. However this was the first attempt by anyone to project an estimated number of enterprises and the study does not purport to be 100 percent accurate.

Table 1.--Private outdoor recreation enterprises

	Number	Percent
Multiple water-oriented enterprises	7,856	6
Swimming	22,195	17
Boating	4,449	3
Fishing	10,138	8
total water-oriented	(44,638)	(34)
Multiple land-oriented enterprises	8,128	6
Lodgings	17,577	13
Camping(overnight and day)	6,273	5
Hunting	13,651	10
Active participation games or activities	25,991	20
Passive spectator and miscellaneous	15,591	12
total land-oriented	(87,211)	(66)
Total number of enterprises investigated	131,849	100

It can readily be seen that the assessment is far from complete, and many of the wide range of activities and facilities that were surveyed do not contain complete information; however, it was a beginning and called attention to the magnitude of this aspect of the recreation estate.

A further effort to assess the public and private recreation estate was done by the Bureau of Outdoor Recreation in its "Outdoor Recreation, A Legacy for America" in 1973. That report indicated that at the time the private sector owned or operated as much acreage as the public sector and involved more people and much wider variety of organizations and interests as well as activities. More than 50 percent of all recreation opportunities are directly attributed to the private sector.

A quick review of these supply data on recreation enterprises will suggest three major categories. (a) Commercial, (b) Private Membership, (c) Private - nonprofit, open to the public. A comparison of these holdings and enterprises in relation to public areas is shown in Table 2.

Table 2.--Number, acreage, and one year's attendance of public and private outdoor recreation areas

	Sites	Acres	Attendance
	number	------thousands-----	
Federal	2,127	446,616	537,065
State	18,614	39,701	420,468
County	4,048	2,977	194,317
Municipal	40,030	2,004	1,562,101
Total public	65,219	491,298	2,713,951
Private(profit)	131,626	30,025	1,251,876
Private (nonprofit)	1,000,000	467,000	800,000

An estimated 85,000 commercial enterprises on 131,000 sites with over 30 million acres provided over one billion outdoor recreation opportunities. These range from dude ranches, and resorts to hunting guides, and outfitting services, charter fishing boats, golf courses, shooting preserves and commercial campgrounds. Another 2000 enterprises provide outdoor recreation facilities and services relating to amusement and spectator sports activities.

More than one million individual enterprises provided outdoor recreation opportunities to the American people without a profit motive. It is estimated that they control over 467 million acres of land, and receive about 800 million visits a year. Of this number there were at the time of the study an estimated 47,000 private and quasi-private nonprofit organizations and an estimated 32,000 membership clubs in this group.

NATIONAL ASSOCIATION OF CONSERVATION DISTRICTS' STUDY

In 1973 the BOR initiated a program to inventory all of the private recreation businesses in the U.S. Cooperation was obtained from the National Association of Conservation Districts. The Association requested the assistance of the Soil and Water Conservation Service through their county Conservationists which cover over 96 percent of the nation's area, through 29,000 soil conservation districts. The local district conservationists enlisted the help of the state departments of conservation, extension specialists and others to inventory and categorize each outdoor recreation enterprise in each county.

Table 3.--National Association of Conservation Districts private sector recreation inventory--number of enterprises

Enterprises	Profit	Non-profit	Total
Campgrounds	11,619	6,087	17,706
Field sports	742	2,805	3,547
Fishing waters	6,931	2,892	9,823
Golfing facilities	5,395	3,765	9,160
Historical/Archaeological site	351	938	1,289
Hunting areas	2,231	3,861	6,092
Natural scenic	346	838	1,184
Picnic areas	528	1,277	1,805
Race tracks	998	243	1,241
Recreation	5,550	306	5,856
Rockhounding	85	17	102
Rodeo,zoo,amusements	2,469	894	3,363
Shooting preserves	793	1,192	1,985
Snow ski areas	510	105	615
Trails	2,103	672	2,775
Vacation farms	909	65	974
Water sports	7,697	2,729	10,426
	49,251	28,686	77,943

Number of states included=47

The Soil Conservation Service had previously been involved in efforts to assess the private recreation potential in the various counties in the nation. In 1962 the initial portion of a three phase plan was begun. Each county was to be inventoried concerning the private recreation enterprise in that county. Because of lack of emphasis by some states the inventory was never completed or published.

In 1970 additional efforts were made to complete the inventory and to do a county-by-county assessment of the potential for private outdoor recreation development to provide a tool for potential areas or sites for recreation business, a very noteworthy purpose. However this study has not yet been completed either, and few know of its existence. It is unfortunate that such efforts, although well-intended and adequately conceived, have not received sufficient emphasis or priority from top administrators to result in their completion.

A comparison of the total number of enterprises reflected in the 1965 BOR inventory and the totals above from the NACD study show some differences. There is no question that the NACD figures are by far the most accurate because of the total inventory attempted, and because of the limitations of the 1965 BOR study previously mentioned.

Table 4.--National Association of Conservation Districts, private sector recreation inventory--types of activities offered by enterprises

Activity	Number of Enterprises		
	Profit	Nonprofit	Total
Camping-canoe	213	99	312
Camping-day	829	1,108	1,937
Camping-pack	288	259	547
Camping-resident	2,413	2,094	4,507
Camping-transient	3,228	403	3,631
Camping-vacation	6,792	843	7,635
Archery	888	1,536	2,424
Shooting range	1,082	2,052	3,134
Tennis	1,756	2,332	4,088
Fish-ponds/lakes	7,256	3,721	10,977
Fishing enterprises	5,924	934	6,858
Golf-driving	1,783	780	2,563
Golf-executive	337	110	447
Golf-miniature	1,284	91	1,375
Golf-par 3	528	184	715
Golf regulations	3,538	2,903	6,441
Historical/archeological	543	976	1,519
Hunting total area	2,616	3,636	6,252
Hunting	4,123	5,600	9,723
Natural scenic	1,273	1,219	2,492
Picnicking	2,777	6,321	9,908
Racing-viewing	1,131	179	1,310
Recreation resort	3,047	164	3,211
Rockhounding	234	52	286
Rodeo,zoo,park	2,511	956	3,467
Shooting-preserve	506	934	1,440
Snow skiing	1,212	275	1,487
Trails total	3,317	1,812	5,129
Bicycle trails	549	182	731
Hiking trails	2,650	2,248	4,898
Horse trails	3,002	583	3,540
Off-road vehicles	472	161	633
Snowmobiling	821	460	1,281
Vacation farm	561	8	569
Vacation ranch	430	16	446
Boating-nonmotor	5,344	1,126	6,470
Boating-motor	4,665	339	5,004
Boating-launch, storage	10,479	2,163	12,642
Swimming	11,251	6,883	18,084

An example of an individual state inventory as part of the NACD study is given for later comparisons with other inventories yet to be discussed.

Table 5.--NACD Private Sector Recreation Inventory, state summary of enterprises Missouri

Primary Facility	Profit	Non-Profit	Total
Campground	343	185	528
Field sports	30	54	84
Fishing waters	467	76	543
Golfing fac.	128	143	271
Hist/Arch site	26	44	70
Hunting areas	37	130	167
Natural scenic	22	15	37
Picnic areas	13	39	52
Race track	35	31	66
Recreation res	429	7	436
Rockhounding	2		2
Rodeo,zoo,amus	115	68	186
Shooting pres	9		9
Trails	41	18	59
Vacation farms	3		3
Water sports	197	74	271
State totals	1,900	884	2,784

STANDARD INDUSTRIAL CLASSIFICATION SYSTEM(SIC)

The U.S. Department of Commerce and the Bureau of Census have produced a much overlooked source of valuable information relating to categories of recreation supply. Information is given on a number of categories of enterprises, total number of establishments, and total number of employees. These categories include: hotels, motels, tourist camps; trailer parks; sporting and recreational camps; motion pictures and services; cultural events; bowling alleys, billiards, pool establishments; other amusements such as dance halls; commercial sports, baseball, football, etc.; racetrack operations; golf courses; skating rinks; amusement parks; carnivals, circuses; other commercial recreation and amusements.

In most cases however, quasi-public agencies are not included. It also can readily be seen that many of the categories do not lend themselves to strictly outdoor recreation facilities, nor to categories consistent with other agencies or organizations interested in trend data.

THE PRIVATE OUTDOOR RECREATION ESTATE STUDY

A report submitted to the Heritage Conservation and Recreation Service (previously BOR) for the Nationwide Outdoor Recreation Plan in August, 1978 by Cordell, Legg and McLellan is probably the most comprehensive description of the private recreation estate for outdoor recreation to date. The study is actually a summary of three other studies done previously.

The first source of data in this study is the Nationwide Survey of Private Landowners and Managers (by the U.S. Forest Service and others, 1977). The survey was begun in late 1976 and samples non-corporate and corporate forest and range landowners concerning their land, the purposes and styles of management exercised, and the public recreational use policies in effect. The study focuses primarily on land use, and sheds little light on the numbers or purposes of the main commercial or private recreation enterprises for profit. It does however shed valuable light on areas that might be available in the future for recreation from private sources.

The second source of data in the study is the Inventory of Private Recreation facilities compiled in 1974-75 by the National Association of Conservation Districts, discussed previously. The data describe the developed recreation site opportunities provided by the private sector, by regions, according to the following classes of activities, and reports them in per capita supply and units per million population.

Class I:	high density facilities, such as swimming pools, golf courses, miniature golf, driving ranges, racetracks, zoos, parks and playgrounds.
Class II:	camping sites, shooting preserves and hunting areas, natural scenic areas, picnic tables, resorts, geological parks, snow skiing, trails, ORV areas, and vacation farms and ranches.
Class III:	water oriented sites and facilities.
Class IV:	historic sites.

The third source of data included in the study is a previous study of recreational properties, subdivisions, and vacation homes, compiled by Richard Ragatz Associates, Inc.[1]

While the summary study for HCRS does add a considerable amount of accurate data to the recreation supply, a valuable data on recreational land use, it still lacks much in answering the questions of trends for landowner use or numbers and types of private and commercial recreation enterprises which is so very much

---

[1] Ragatz, Richard L. Associates, Inc. 1977. Private seasonal recreational property development, unpublished report done for the U.S. Dept. Agric. For. Serv., Southeastern For. Exp. Stn., Clemson, S.C.

Table 6.--NACD Private Sector Recreation Inventory
Missouri state summary of activities and enterprises providing activities

Activity	Amount of measured units						Enterprise		Total
							PROF	N/P	TOT
Special							16		16
Camping-canoe	473	areas					23	4	27
Camping-day	12652	acres	20149	guests			28	55	83
Camping-pack	79	areas					4	2	6
Camping-resident	9882	acres	11150	guests			27	58	85
Camping-transient	7450	acres	5835	veh-sites	19142	tent-sites	123	14	137
Camping-vacation	15741	acres	7227	veh-sites	6520	tent-sites	128	20	148
Archery	56	ranges	287	positions			16	27	43
Shooting range	879	positions					31	53	84
Tennis	363	courts					29	80	109
Fish-ponds/lakes	10467	acres	891	pond/lake			275	122	397
Fish enterprises	3234	acres	966	enterprises			208	6	214
Golf-driving	472	acres	924	positions			38	10	48
Golf-executive	428	acres	81	holes			4	3	7
Golf-miniature	124	acres	997	holes			51		51
Golf-par 3	97	acres	54	holes			4	1	5
Golf-regulation	17124	acres	2256	holes			67	113	180
Hist/Archeological	3091	acres	119	sites			32	41	73
Hunt total area	50744	acres					20	71	91
Hunting	25828	B/G-acres	28126	S/G-acres	13615	W/F-acres	59	132	191
Natural/scenic	13511	acres	15	road miles			33	30	63
Picnicking	4538	acres	5310	tables			194	113	307
Racing-viewing	2201	acres	131265	spectators	830	track miles	39	30	69
Rec resort	10143	acres	23505	guests			356	8	364
Rockhounding	7	acres	230	guests			1	1	2
Rodeo,zoo,park	8532	acres					132	69	201
Shooting-preserve	3361	acres					11	1	12
Snow skiing	40	acres	2200	pers/hr			1		1
Trails total	569	miles					44	32	76
Bicycling trail	19	miles	106	rentals			10	2	12
Hiking trails	449	miles					56	57	113
Horse trails	630	miles	1208	rentals	1209	boarded	73	21	94
Off-road veh	9304	acres	83	miles			7	3	10
Snowmobiling	10	acres	1	mile			1		1
Vacation-farm	3	acres	4	guests			1		1
Vacation-ranch	2785	acres	5092	guests			3		3
Boating-non motor	2201	canoes	44	sail	1378	other	294	26	320
Boating-motor	124	charter	2104	rentals			354	6	360
Boat launch/storage	3906	boats	578	ramps/lanes	5881	boat slips	490	23	513
Swimming	104807	beach lin.	12813	pond-acres	1088263	pool sq ft	411	171	582
							3694	1405	5099

Table 7.--Total number of SIC establishments, relating to outdoor recreation

SIC	Kind of Business	Total Number of Establishments				
		1954	1958	1963	1967	1972
793	Bowling alleys, billiard, pool establishments	12701	13916	15927	15497	14320
7932	Billiard and pool establishments	7639	7045	7069	xx	5847
7933	Bowling alleys	5062	6871	8858	xx	8454
79.Ex.792.3	Other amusement and recreation services	30532	42913	49244	52834	xx
791	Dance halls, studios, schools	2265	6869	7301	xx	xx
	Public dance halls or ballrooms	xx	875	869	xx	xx
	Dance schools, incl. childrens, pro.	xx	5994	6432	xx	xx
7941,7948	Commercial sports	2517	6028	6488	xx	xx
	Baseball, football clubs, etc., promoters	672	752	445	xx	xx
	baseball clubs	271	200	158	xx	xx
	football clubs	25	20	41	xx	xx
	other pro athletic clubs	376	448	246	xx	xx
	managers and promoters	376	448	246	xx	xx
7948	Racetrack operation, including racing stables	1845	5276	6043	xx	xx
	automobile racing	454	578	458	xx	xx
	dog race tracks	xx	xx	55	xx	xx
	thoroughbred horse race tracks	xx	xx	235	xx	xx
	standardbred horse race tracks	xx	xx	235	xx	xx
	dog and horse racing stables	xx	xx	5295	xx	xx
7942	Public golf courses	1014	851	1047	xx	xx
7945	Skating rinks	1799	2254	1274	xx	NA
7946	Amusement parks(incl. kiddie, theme parks)	2488	3682	997	xx	xx
7943	Coin operated amusement devices	6045	5264	5038	xx	xx
7949	Concession operators of amusement devices	xx	xx	2776	xx	xx
	carnivals, circuses	1090	801	363	xx	xx
	fairs	1090	320	1257	xx	xx
	other commercial recreation and amusements	13314	16844	22703	xx	xx

needed. It may however provide basic data on which to measure future trends.

STATE SCORP PLANS

Part of the requirements for states to be eligible for federal funds under the Land and Water Conservation Fund Act of 1965 requires that a State Outdoor Recreation Plan (SCORP) be done periodically by each state. A number of states have addressed this requirement differently; however in most cases, there is some private and commercial data available. Unfortunately there is little consistency between states on what was inventoried, or how it was inventoried, thus making state by state comparisons, or totals impossible from this source.

The SCORP for Missouri last done in 1975 included both a demand study as well as a supply inventory. The Missouri SCORP is discussed here only as an example of what may be found in other states and for later comparisons with other studies yet to be mentioned.

The Missouri SCORP did not isolate participation in private or commercial enterprises. The supply inventory however did include one "Type of Control" category shown in Table 10 as "other" which included facilities of the following agencies, organizations and institutions: church, civic, community, club, institution, employee organization, private or parochial school, private for profit, and private not for profit.

Unfortunately the following areas were not included: outdoor movie theatres, horse racetracks, miniature golf courses, auto racetracks, trampoline parks, go kart tracks, professional and semiprofessional football and baseball fields, and some university and college athletic facilities.

While the figures below may be meaningless in terms of comparison with other data, they are included for example purposes partially to show the need for consistent methodology to measure trends.

The inventory lists 1,608 agencies, businesses or institutions controlling 96,822 acres of recreational land. Apparently there was no effort to further scrutinize the data for additional information on private and commercial enterprises.

The 1979 SCORP for Missouri includes a more comprehensive inventory of public and private recreation opportunities.

Table 8.--Total acreage by type of control
Missouri SCORP, 1975

	Number	Acres
Federal	170	1,744,490
State	719	455,613
County	96	11,642
Municipal	1162	38,500
School	1293	7,396
Other	1608	96,822

This reflects a more indepth effort to consider the facilities that are private/profit.

A summary of the figures from the three Missouri studies brings to focus the problems we have been discussing. While the 1979 SCORP does not have numbers of facilities, the data is available to retrieve such information and it may be included in the final document which is still in draft form.

Table 9 .--Summary of enterprises

	Profit	Non-Profit	Acres	Total
NACD	1,900	885		2,784
1975 SCORP		1,608	96,822	1,608
1979 SCORP			214,568	

When compared with the NACD data, the differences are still significant; however, the methodology and accuracy are probably much more reliable in these two surveys than in the 1975 SCORP study.

SURVEY OF PRIVATE ASSOCIATIONS 1979

Realizing the inconsistency of data in government funded studies, whether nationwide or state by state, an attempt was made to contact a number of industry association groups for supply data. Those contacted fell into the following categories. (See Table 11.)

Questionnaires were sent to each of the agencies asking for any kind of participation or facility data that would indicate trends. A second letter was sent thirty days after the first to those who had not responded. Of the 133 questionnaires sent, responses were received from 40 and data was received from 19. While all of the agencies contacted do not relate to "outdoor recreation", they were included because of their close association to outdoor recreation and for other purposes not within the scope of this paper.

Table 10.--Statewide totals for each facility by type of ownership

Facility	Unit	Federal	State	County	Municipal	School	Other	Private Profit	Total
Total area	Acres	1,992,262	442,181	940,680	81,322	35,226	65,401	214,548	3,771,620
Water-Lake	Acres	139,413	3,608,713	743	8,652	59	3,576	911,423	4,672,579
Water-wetland	Acres	55,016	7,328	0	23	3	35	3,288	65,693
Water-stream	Miles	61	6,397	2	3,331	0	2,688	3,638	16,117
Water-river	Miles	403	8,042	20	108	0	130	39,265	47,968
Marina (covered)	Spaces	3,374	249	454	422	6	196	6,737	11,438
Docks (uncovered)	Spaces	338	44	532	350	0	583	2,353	4,200
Access/boat ramps	Lanes	508	170	75	92	16	32	481	1,374
Fast boat	Acres	83,204	360	51	690	0	3,749	2,220	90,274
Slow boat	Acres	81,273	3,606	1,380	5,916	0	5,115	4,590	101,880
Water ski	Acres	126,190	360	65	645	0	3,749	2,300	133,309
Canoe/kayak/raft/tubing	Acres	153,690	1,750	470	3,284	41	4,492	5,883	170,215
Sailing	Acres	153,291	1,261	1,367	1,852	19	4,176	3,328	165,294
Pool unheated	Lighted	59,070	7,110	8,658	942,585	17,100	391,215	1,014,120	2,439,858
	No light	8,721	15,294	24,880	109,225	5,625	75,840	382,484	622,069
Pool heated	Lighted	1,253	0	20	32,823	78,320	53,383	191,928	357,727
Beach area	Acres	1,008	41	0	2	0	0	35	1,107
Regular golf course	Holes	0	18	36	495	72	388	1,161	2,170
Par 3 golf course	Holes	0	0	0	0	0	9	18	27
Driving range	Tees	0	0	0	20	35	136	448	639
Fishing docks/piers	Number	22	12	6	28	4	15	190	277
Rivers/streams-fishing	Miles	173	13,355	3	50	0	331	137	14,049
Rivers/streams-hunting	Miles	131	181	12	0	0	30	2	356
Lakes/impound-fishing	Acres	177,158	9,762	23,025	10,471	48	3,671	12,004	236,139
Lakes/impound-hunting	Acres	51,461	7,477	31	1,805	0	350	65,649	126,773
Ice fishing	Acres	500	2,047	62	1,655	0	1,534	241	6,039
Lands open to hunting	Acres	1,533,778	322,115	574	642	0	4,833	32,399	1,894,341
General sites	Sites	5,946	2,387	846	223	25	480	7,407	17,314
	Acres	931	6,080	810	922	9	324	905	9,981
Tent only	Sites	126	171	147	19	0	78	3,547	4,088
	Acres	5	40	0	20	0	9	115	189
Racquet-handball out	Lighted	0	4	0	11	26	9	3	53
	No light	0	0	4	37	52	7	0	100
Tennis courts/outdoor	Lighted	9	4	14	735	165	65	159	1,151
	No light	7	3	54	329	453	56	171	1,073
Basketball crt/outdoor	Lighted	1	0	1	110	88	18	9	227
	No light	0	5	19	220	1,100	75	58	1,477
Archery ranges outdoor	Points	15	158	167	68	114	100	15	637
Firearm-skeet/trap	Points	0	30	0	175	102	794	331	1,432
Firearm-pistol/rifle	Points	4	51	45	30	999	466	13	1,608
Hang gliding	Acres	1	0	0	1	3	1	8	14

Table 10.--continued

Facility	Unit	Federal	State	County	Municipal	School	Other	Private Profit	Total
Ballooning	Acres	0	0	0	0	0	1	10	11
Model plane	Acres	0	10	32	51	0	5	0	98
Desig. sites-sheltered	Tables	209	494	1,121	5,307	147	764	1,192	9,234
	Shelters	38	125	116	1,050	24	223	618	2,194
Desig. sites-unshelt.	Tables	900	2,595	3,020	5,711	939	1,754	3,452	18,371
	Acres	298	656	636	1,472	16	323	317	3,718
Sled/toboggan/tubing	Acres	3	40	6	338	23	112	53	575
Ice skating-natural	Acres	500	936	20	148	5	529	40	2,178
Ice skating-artificial	Acres	0	0	0	0	0	0	0	0
Ski slopes	Acres	0	1	0	0	0	0	5	6
Zoos	Acres	2	0	143	85	0	0	564	794
Wildlife view. areas	Sites	9	25	11	8	3	30	14	100
Interpretive center	Centers	16	10	8	11	1	12	7	65
Hist/Arch sites	Sites	8	40	52	144	3	26	11	284
Signed vistas	Number	11	18	5	28	0	2	1	65
Amphitheatre-developed	Seats	875	640	160	28,561	101	6,216	197	36,750
Springs-developed	Number	32	13	1	23	3	6	24	102
Caves-developed	Number	2	42	5	1	4	2	18	74
Horse arena/rodeo	Number	2	0	10	58	12	78	34	194
Fair grounds	Number	0	0	19	25	3	15	3	65
Camping	Acres	21	16,434	80	495	0	2,494	1,363	20,887
Picnicking	Acres	45,418	26,546	432	2,791	715	7,085	810	83,797
Hike/walk	Acres	157,966	98,046	1,172	3,893	751	11,109	8,264	281,201
Play area	Acres	15,108	543	1,391	5,370	1,654	3,434	376	27,876
Wildlife watching	Acres	128,804	99,900	2,552	2,067	163	15,148	12,675	261,309
Rock climb/rappelling	Acres	0	85	0	0	0	71	2	158
Trailer/camper	Sites	1,577	272	450	356	1,381	258	5,617	9,911
	Acres	1	0	0	1	0	0	94	96
Backpacking sites	Sites	49	2,148	0	0	0	26	0	2,223
	Acres	0	7,042	0	0	0	666	8,005	15,713
Group sites	Acres	199	42	129	129	30	297	50	876
	Number	2	12	79	48	0	69	32	242
Group camps	Number	0	33	65	38	0	314	24	474
Bicycle	Mi trail	0	2	15	55	1	4	2	79
	Mi lane	0	0	8,625	17	0	0	0	8,642
Horse	Miles	137	201	81	18	1	44	257	739
Hiking/foot/backpacking	Miles	247	284	156	55	10	182	258	1,192
Nature/interpret, walk	Miles	28	56	24	45	7	31	46	237
Nature/interpret. drive	Miles	0	62	12	13	0	12	4	103
Motorbike/motorcycle	Miles	2	100	2	14	1	10	50	179
	Acres	63,960	6,258	50	3	0	1	1	70,273

Table 10.--continued

Facility	Unit	Federal	State	County	Municipal	School	Other	Private Profit	Total
Fitness trails	Miles	0	3	9	12	18	1	14	57
Water based trail	Miles	4	0	0	3	0	3	20	30
Off road 2-wheel drive	Miles	0	108	0	3	2	25	54	192
Off road 4-wheel drive	Miles	0	45	0	0	0	20	30	95
	Acres	0	6,257	0	0	0	0	0	6,257
X-country ski/snowshoe	Miles	0	8	11	83	0	0	0	102
Snowmobile	Miles	0	0	2	0	0	0	20	22
Apparatus area	Acres	10,918	48	3	506	714	51	887	
Tot lot	Acres	10	6	0	19	5	9	7	
Multiple use courts	Lighted	12	13	2	112	6,085	37	59	6,320
	No light	0	20	2	210	18,488	45	36	18,801
Multiple use area	Acres	10,126	140	78	764	3,263	566	307	15,244
Baseball/softball field	Lighted	4	2	15	546	334	94	25	1,020
	No light	4	15	53	597	1,261	159	51	2,140
Football/soccer	Lighted	1	98	1	57	197	3	4	361
	No light	2	0	23	158	309	20	7	519

Table 11.--Industry Association survey

		Responses	Returned Trends
Amusements-fairs	9		
Back packing	1	1	1
Bicycle	9		
Billiards	1	1	
Boating	7	2	2
Bowling	5	2	1
Camping	6	3	
Campgrounds	5	1	
Canoeing	2	1	
Conventions	3		
Cultural	9	1	
Farm-dude ranch	3	1	
Golf	9	6	2
Hockey	1		
Hotels,motels,resorts	14	4	2
Motorcycles	3	2	
Planning	2	2	
Restaurant	4	1	1
Skating-roller	2	1	1
Skating-ice	1		
Skiing-water	1		
Skiing-snow	14	7	4
Snowmobiles	3	1	1
Swimming	1		
Tennis	7	2	2
Travel	11		
TOTALS	133	40	19

The response was disappointing to say the least. A majority of those who did return trend data only had information on a region or other fraction of the total industry itself. A problem with industry data is that it is industry produced. While the integrity of the various industries is not being questioned, the consistency of the reliability and validity leaves questions in the minds of many. The temptation may be too great for some. Several have their own outside funded foundations for education and research such as the golf and tennis foundations. Even in reporting the statistics these do not fully describe the methodology of their research.

PUBLIC SOURCES

Those desiring information on trends in private and commercial facilities and participation may be left to rely on occasional articles found in the news media, or those offered for a fee from private organizations. Several articles of note in recent times include the following:

Scherman, Tony, "The Thrill of It All," Family Weekly, November 11, 1979.

"Summertime and the Spending Is Easy," U.S. News and World Report, July 31, 1978, pages 16-17.

"How Americans Pursue Happiness," U.S. News and World Report, May 23, 1979, pages 60-76.

"Leisure Boom-Biggest Ever and Still Growing," U.S. News and World Report, April 17, 1972, page 42.

These furnish tidbits of information on participation, facilities, and spending of Americans on a variety of sports and leisure activities, although there appears not to be any consistency in the activities chosen.

The most comprehensive source of these isolated pieces of information on existing participation, spending and facilities is probably Epperson's book, "Private and Commercial Recreation" (1977) pages 74-80. However it too is a collection of statistics from a variety of sources, some of them highly questionable, and the data is now three years old.

Other limited sources have included studies done by government agencies but not published such as "The Importance of Recreation to the Economy" (Beaver 1978).

Data from private sources for a fee include the Travel Pulse, a research publication based on 5,000 indepth home interviews annually.

Another excellent source on sports and leisure participation in the private sector is the Nielsen studies. These have received very little attention in the public sector.

These studies are based on telephone interviews with some 3,000 households and representing over 8,500 individuals, and a study of thirty different sports. They provide trend and demographic information on individual participants as well as households and also include data on equipment purchases for most sports. They also include special tabulations covering a variety of topics for specific sports. Sports covered in the survey include: archery; baseball(hardball); basketball, indoor and outdoor; bicycling; boating; bowling; camping; fishing; football; golf; handball; hunting; ice hockey; ice skating; jogging/bicycling; motorbiking; paddle tennis; platform tennis; pool/billiards; raquetball; roller skating; sailing; snowmobiling; snow skiing; soccer; softball; swimming, indoor and outdoor; table tennis; tennis, indoor and outdoor; and water skiing.

Many sports equipment manufacturers and market analysts use the reports, available for a fee from the company. It appears that private enterprise has again accomplished something that public institutions have not.

SUMMARY

It is evident that there is no existing system or program either public or private that can track annual changes in private and commercial facilities or enterprises. There has been substantial growth in programs to track changes in participation of selected activities. However because this data has been produced by private enterprise, there is a substantial cost involved in obtaining the statistics. The economic feasibility will no doubt determine in the future which additional sports and activities are researched.

The only other alternative for the future, in terms of complete trend data, is to encourage the various industries themselves in groups to do so. This might be done through such organizations as the American Recreation Coalition, recently formed through the Discover America Travel Organization in response to gasoline allocations and possible rationing. This organization, a group of 48 agencies and industries relating to recreation, have met several times and perhaps could provide a vehicle for possible trend data collection. The limitations of industry produced statistics would still be present.

Another possibility is for the group such as the Travel and Tourism Industry Advisory Council, appointed by the Senate Committee on Commerce, Science and Transportation as an advisory arm to the Subcommittee on Merchant Marine and Tourism, to put this as a high priority item. While their first meeting was in July, and their agenda and minutes are not open to the public, there are a number of nationally known persons active in recreation, travel and tourism on the Committee.

It may be unlikely however that any governmental vehicle can be used to produce such a product because of the changing nature of politics, policies, regional differences in procedures and time required to accomplish the task. A recent effort at providing input into the National Recreation Plan for HCRS by a task force on private recreation is an example. Description of the problem is not important at this point, but those involved can attest to the problems with such studies and reports through traditional governmental agencies.

What is the answer? This author isn't sure. Perhaps this conference will help find some answers.

LITERATURE CITED

Beaver, Thomas D. 1978. Importance of recreation to the economy. Heritage Conservation and Recreation Service, Washington, D.C.

Bureau of Outdoor Recreation. 1965. The 1965 nationwide inventory of publicly owned recreation areas and assessment of private recreation enterprises. Superintendent of Documents, Washington, D.C.

Bureau of Outdoor Recreation. 1973. Outdoor recreation, a legacy for America. Superintendent of Documents, Washington, D.C.

Chilton Research Services for the Bureau of Outdoor Recreation. 1966. Private sector study of outdoor recreation enterprises. Superintendent of Documents, Washington, D.C.

Epperson, Arlin F. 1977. Private and commercial recreation. John Wiley, New York, New York.

Missouri Department of Natural Resources. 1975. Statewide comprehensive outdoor recreation plan. Department of Natural Resources, P.O. Box 176, Jefferson City, Missouri.

Missouri Department of Natural Resources. 1979. Statewide comprehensive outdoor recreation plan. Department of Natural Resources, P.O. Box 176, Jefferson City, Missouri.

Nielsen, A.C. 1979, 1976, 1973. Sports participation. Nielsen Company, Northbrook, Illinois.

Travel and Tourism Consultants International. 1979. Travel Pulse. New York, New York.

U.S. Forest Service and others. 1977. Nationwide survey during 1977 and 1978 on noncorporate, corporate, and government landowners and managers. A cooperative effort between the U.S. Forest Service, the Soil Conservation Service, Clemson, South Carolina.

TRAVEL TRENDS AND ENERGY

Paper presented at the National Outdoor Recreation Trends Symposium,
Durham NH, April 20-23, 1980

Thomas M. Corsi, Assistant Professor of Transportation, University of Maryland, College Park, MD
Milton E. Harvey, Professor of Geography, Kent State University, Kent, Ohio

Abstract.--This paper utilizes available data sources to construct a picture of adjustment patterns in vacation/recreation travel with respect to both past and prospective fuel price/availability developments. The increases in fuel prices coupled with supply uncertainties that have occurred during the 1970's have strained the traditional vacation patterns of many American households. Changes in the location of outdoor recreation centers will follow as a consequence of the new travel patterns.

INTRODUCTION

A geographer, Prof. Wilbur Zelinsky, incisively suggested that one of the four major attributes of the American ethos was excessive mobility. This mobility consists of many components including the ubiquitous journey to work, the journey for vacation and recreation and residential relocation. It should be noted, however, that when Zelinsky wrote his book, Americans had not experienced the trauma of the 1973 OPEC oil embargo, nor was the nation under the constant spectre of increasing fuel prices, and the ever pervasive gloomy forecasts, by various organizations, of impending shortages. Basically, therefore, the environment within which American mobility patterns are generated has changed from an almost frictionless space to a constrained high-friction space. The resultant spatial patterns have to be different. The aim of this paper is to briefly identify recent changes in recreation travel within the United States and the socio-economic foundations of those changes.

CONCEPTUALIZATION OF CONSTRAINED RECREATION TRAVEL

The present pattern of recreation travel is constrained at two interrelated levels: the national availability of gasoline and the financial reallocations by individual households. The national availability of gasoline has affected travel behavior by intermittent shortages due to supply cut-offs and by more effective control over the quantity available. While the latter has caused a gradual rise in the price of fuel, the former has occasionally created rapid price increases from which the general trends in fuel prices never completely recover. The impact of fuel price increases over a period of time has led to a change in attitudes. Gradually, more and more Americans now believe that the fuel crisis is real indeed and that technological solutions are many years from fruition. This attitude change has necessitated the search by families for ways of adjusting to these higher financial demands on the family budget.

The income of the average American family has been increasing at a rate that is below that of general inflation as well as fuel price increases. Consequently, since budgetary reallocations have not been sufficient to alleviate the financial burdens incurred by families because of these fuel price increases, many households have had, and will in the future have, to make spatial adjustments in their travel. Basically, the types of adjustments fall into four broad categories: activity space reduction, activity mode change, activity frequency reduction, and activity type change. Naturally, the combinations of these adjustment packages which an individual household adopts vary by the stage in the life cycle, the socio-economic status, the region of residence, and the changes in the price of fuel. In this paper, we will attempt to discuss the changes in vacation/recreation travel behavior using these four types of adjustments as our framework. The specific research questions that emerge from these discussions constitute our research foci: (a) What are the trends in the changes in the recreation activity space?; (b) What are the trends in mode shifts for recreation?; (c) What are the trends in the frequency of participation?; and (d) What are the shifts in the types of activities? Together these cover the broader topic of travel trends and energy.

THE DATA

One of the most frustrating things for researchers without the funds to collect their own data is the availability of the 'right' data. In such instances, the researcher has to use the best available data and in many instances such data may not be quite adequate for the specific questions under investigation. As a result, conclusions may be tenuous and may lack comparability of scale and geography. In spite of this, the findings may be useful for the identification of basic trends.

In our search for data, the authors investigated many data sources, and finally decided that they would use information from the following sources:

1. Data from the 1975 Southeastern Wisconsin Regional Planning Commission (SEWRPC) Energy Use Travel Survey in which the authors were involved. That questionnaire was developed to determine how shortages and higher prices of gasoline have, in the past, influenced and may, in the future, influence the travel habits and patterns of households. The questionnaire was mailed to a random sample of 9,881 individuals in the Southeastern Wisconsin region during November 1975. Over 1,461 or 14.8 percent usable returns were received (Corsi and Harvey, 1978, 1979).

2. Data from the 1977 Nationwide Outdoor Recreation Survey's General Population Survey on outdoor recreation were also used. These data are based on a national sample of 4,029 households surveyed by telephone in June 1977. For this paper, we are interested in the questions dealing with the impact of present gasoline prices on the number of trips, the length of the trip, the frequency of trips, the mode used for outdoor recreation activities and the effect of possible gasoline price doubling in the next six months on the number of trips. The survey was conducted by Opinion Research Corporation of Princeton, New Jersey under contract with the Heritage Conservation and Recreation Service (formerly the Bureau of Outdoor Recreation).[1]

3. Data from the 1977 Nationwide Outdoor Recreation's Federal Estate Survey were also used. This survey, which focussed on some of the questions in the National General Population Survey, was conducted at selected recreation areas within the Federal Estate (i.e. all federally-owned land managed at least in part for public outdoor recreation activity) during the winter, summer, and fall months of 1977 by the Heritage Conservation and Recreation Service (HCRS). A total of 13,729 interviews were completed.

4. The authors also employed data from the National Travel Survey, one component of the Census of Transportation conducted by the U.S. Bureau of the Census. Its purpose is to provide statistical data on the volume and characteristics of all non-commuting trips totalling 100 miles or more from origin to destination. All surveyed households provided information on the trips taken (such as mode of travel, trip purpose, trip expenditures, etc.) by every member of the household during the relevant year as well as on the general socio-economic characteristics of the household. The results from the three surveys conducted thus far for the years 1967, 1972, and 1977 are now available (U.S. Bureau of the Census, 1977, 1979).

5. Data from a survey of households in six metropolitan centers (Chicago, Dallas-Fort Worth, Los Angeles, New York City, Phoenix, and Salt Lake City) conducted in April and May 1979 was used. Approximately 1500 randomly-selected households received the survey in the mail. After follow-up efforts, the response rate was 23.1 percent. The direct focus of the survey was on actual and potential changes in recreation travel in response to the availability and price of fuel (Burke and Williams, 1979).

6. The authors considered a sampling of 1500 residents in the State of New York during November 1979. The survey assessed

---

[1] Both the General Population Survey and the Federal Estate Survey are components of the 1977 Nationwide Outdoor Recreation Survey. The 1977 Survey is the sixth in a series of national household surveys conducted by the Heritage Conservation and Recreation Service and its predecessors, the Bureau of Outdoor Recreation and the Outdoor Recreation Resources Review Commission. The primary purpose of the 1977 Survey was to provide background information for the Third Nationwide Outdoor Recreation Plan of which it is an appendix. The Plan's will be published by the HCRS, U.S. Dept. of the Interior in early 1980.

actual travel behavior response to the huge increases in fuel prices and supply interruptions experienced during the summer of 1979 and anticipated changes in response to additional fuel price increases and supply restrictions. Although the survey emphasis was not specifically on recreation travel, it was included as an important travel category.[2]

THE ANALYSIS - TRENDS IN ACTIVITY SPACE

Although the SEWRPC survey was restricted to Milwaukee, its results concerning activity space reduction recreate a backdrop for analyzing the trends in this process. Elsewhere, and using the SEWRPC data, we observed that the number of households who said they would either cancel vacation plans or take a vacation of a shorter distance increases as they were questioned about their perspective responses to increasingly higher fuel prices.

Since 1975, the price of fuel has continued to rise, and if the intended adjustment patterns reported by Corsi and Harvey hold, the proportion of the population who have effected some modifications in their recreation space should be increasing. The 1977 Nationwide Outdoor Recreation's General Population Survey of 1977, reported that 49 percent of the sample population said that the price of gasoline at that time had caused them to make shorter trips for outdoor recreation activities. In contrast 47 percent said it did not. The 49 percent positive response indicates that a reduction in the activity space for outdoor recreation is increasing. From present data we cannot accurately determine the rate of spatial shrinkage in this activity space. However, we do have information about regional and socio-economic variations in this process. Basically, the data indicate that:

i. The percent of the sample population, in each of the ten Federal regions, who said they made shorter trips than normal because of the gasoline prices at the time of the survey, was higher than 44 percent. Overall, the high ratios of people who took shorter trips is encouraging indeed; it indicates the consistent reduction in the activity space.

ii. Regarding income, the data revealed that although all income categories exhibit appreciable percentage of people who took shorter distances, lower and lower-middle income families, with incomes of up to $15,000, showed a greater tendency to take shorter trips than families with higher incomes. For example, while 56 percent of the households with incomes between $6,000 and $10,000 said they took shorter outdoor recreation trips as a result of fuel prices at the time of the survey, the corresponding figure among households in the $25,001 to $50,000 income range was only 33 percent.

iii. The above pattern is reinforced by the data for various occupational groups. While under 50 percent of the households in the professional, managerial and clerical (sales) groups took shorter trips for outdoor recreation activities, the proportion was considerably higher for the other occupations.

iv. Reinforcing the dichotomy between higher and lower status families in activity space modification is the tendency for a higher percentage of those with under 12 years of education to take shorter trips in response to fuel prices than of those with more than 12 years of education. The respective percentages are 57 (among those with between 9 and 11 years of education) and 39 (among those with 17 years or more of education).

v. Other interesting results form that survey include the greater tendency for people in rural areas, households with larger families and non-whites to take shorter trips because of the price of gasoline.

Although the exact yes/no ratios were consistently lower, the above general tendencies emerged from the Federal Estate Survey conducted in the same year.

Comparison of results from the 1972 and 1977 National Travel Surveys indicate convincingly the increasing importance of shorter-distance trips in the travel patterns of American households as the country moved away from an era of inexpensive fuel and abundant supplies (1972) to an era of higher prices and supply uncertainties (1977).

In 1972 trips (for all purposes, including vacation, recreation, business, etc.) with a round trip distance of between 200 and 399 miles accounted for 39.59 percent of all trips, while the comparable figure in 1977 was 49.51 percent -- an increase of 9.92 percentage points. Trips in all mileage categories greater than 399 miles accounted for a smaller percentage of total trips in 1977 than in 1972.

---

[2] Mr. Davis T. Hartgen, Director of the Planning Research Unit, New York State Department of Transportation, made the results of the 1500 household survey available to the authors for this analysis. This assistance was greatly appreciated.

The results are even more striking when the focus is outdoor recreation trips exclusively. In 1972 trips between 200 and 399 miles made up 47.8 percent of all outdoor recreation trips, while the comparable percentage in 1977 was 60.4 percent -- an increase of 12.6 percentage points. Trips in the 400 to 599 mile category fell by 3.43 percentage points from 20.99 percent of outdoor recreation trips in 1972 to 17.56 percent in 1977. In all other mileage categories, there were a smaller percentage of the total trips in 1977 than in 1972 (Table 1).

The above patterns are repeated when either vacation trips or weekend trips are analyzed. As opposed to the Milwaukee data or the Outdoor Recreation Survey, the National Travel Survey data gives the only concrete evidence of the actual reduction in mileage driven by Americans for various trip purposes.

In a more general way, the survey of six metropolitan areas during the spring of 1979 indicated that the substantial price increases as well as supply restrictions that occurred in that year further influenced trip distances for vacation/recreation travel. In addition, the results suggested that further adverse changes in price and supply of fuel would exacerbate the trend toward shorter vacation/recreation trips.

Table 2 shows the relationship between varying fuel price levels/supply restriction programs and vacation travel distances. About one half of the respondents who had travel plans at the time of the survey said they would not travel if fuel prices increased dramatically and/or restrictions were placed on supplies. Of those continuing to travel, a higher percentage would take shorter as opposed to longer trips. At currently pricing levels, 8.6 percent of the respondents said that their vacation trips involved less than 100 miles. However, if gasoline prices rose to $2.00 a gallon or rationing occurred, the corresponding percentages would be 12.1 and 11.2, respectively, including the approximately 50 percent who would stop traveling. Thus, among the travelers, the percentage of all trips accounted for by those under 100 miles would be approximately twice the 12.1 and 11.2 figures cited above. In contrast, at current pricing levels, 21.2 percent of the respondents have vacation plans involving trips of 2000 miles or more. However, that figure drops to 4 percent as gasoline prices rise to $2.00 a gallon and 4.4 percent under a rationing plan. Again, these figures would approximately double if nontravelers were excluded.

Finally, the New York State survey, taken in the immediate aftermath of a period in which gasoline prices rose 35 cents per gallon and supply shortfalls reached 13 percent for limited periods, showed a willingness among households to respond by taking shorter vacation trips. Approximately 16 percent of the households said that in response to the 1979 situation of price increases/supply interruptions they had moved their vacation destinations closer to home. Households were then asked what their response would be to gasoline prices of $1.50 per gallon and a 20 percent supply reduction (but no formal rationing program). In response to the higher price situation and in response to the supply shortfall, 22 percent of the households said they would vacation closer to home.

Although these latter percentages are somewhat lower than responses given to similar questions in the 1977 Nationwide Outdoor Recreation survey, we might make two observations. First, the New York State results may not be representative of the response. Second, between 1977 (the date of the Nationwide Outdoor Recreation survey) and 1979 (the date of the New York State survey) a number of households had already shortened their vacation distances. As a result, the percentage able and willing to make further reductions would be lessened. Unfortunately, the lack of comparability among data sets makes more definitive statements impossible.

From the available evidence, we can tentatively and very cautiously conclude that the rising price in gasoline has resulted in the substitution of nearby places for far away places for outdoor recreation. This reduction in the activity space for vacation/recreation trips reflects, conceptually, the increasing patronization of intervening opportunities and the gradual evolution of a vacation/recreation activity space characterized by extreme distance friction. With continued gasoline price increases, we expect this shrinking to continue, at least, for the next few years. This statement needs clarification. Present trends in technology as manifested in more fuel efficient automobiles and the possibility of more abundant alternative fuels would, to a limited extent, counteract the influence of rising gasoline prices. Consequently, we believe that, over time, the interaction of all these forces would produce 'optimally' compact outdoor recreation activity spaces. However, more concrete research is needed before more concrete empirically-based conclusions are possible.

ANALYSIS-TRENDS IN ACTIVITY MODE CHANGE

One of the most persistent tendencies in studies of mode change is the general unwillingness by the majority of Americans to give up the family automobile for recreation activities. The flexibility, privacy and comfort of the automobile over other modes explains, in part, this persistency. After the OPEC embargo, all the studies on mode change confirmed this persisting tendency. HCRS's 1977 surveys (the Federal Estate Survey and the General Population Survey) indicate that although the proportions of the population in various geographic and socio-economic groups that increased their use of public transportation for outdoor recreation are high, the shifts are not as dramatic as in the case of activity space reduction.

The results of the General Population survey showed that only 15 percent of those surveyed said that the price of gasoline at the time of the survey had caused them to use public transportation for outdoor recreation in contrast to the 47 percent who made shorter trips. However, such variables as income, family, and race seem to influence the propensity to utilize public transportation more frequently. Individuals in the lowest income brackets were more likely than those in the higher income brackets to utilize public transportation for outdoor recreation travel. While 22 percent of individuals with family incomes under $6,000 said they used public transportation more frequently as a result of higher prices, the matching figure among those with income between $25,001 and $50,000 was only 9 percent. In addition, while only 12 percent of those in family units of two members said they used public transportation more frequently, the comparable figure among those in family units of seven or more members was 27 percent. Finally, while only 12 percent of the white respondents said they used public transportation, the matching figure for blacks was 33 percent.

Results from the 1972 and 1977 National Travel surveys reinforce the argument that fuel price increases/supply uncertainties have not separated Americans from their automobiles. In 1972, 94 percent of all outdoor recreation trips were by the auto-truck mode. By 1977, this percentage had shown only a slight decline to 91 percent. This change was accounted for by slight gains by the bus, train, and airplane modes. In 1972 these modes were involved in 1.8, 0.1, and 3.2 percent, respectively, of the outdoor recreation trips. By 1977, these percentages increased to 3.6, 0.2, and 3.9 percent, respectively. The doubling in the percentage of outdoor recreation trips accounted for by the bus and train modes, while of importance, are small in magnitude compared to total travel. The unmistakable overall conclusion from the two surveys is that through 1977 Americans preference for the automobile for vacation/recreation travel remained firm.

Results from the survey of households in six metropolitan areas during 1979 supports the proposition that the automobile/recreation vehicle is the dominant mode for vacation/recreation travel. Table 3 clearly shows that additional fuel price increases above the current levels at the time of the survey would bring about major changes in the decision of households to travel and only modest increases in the use of public transportation. Thus, the use of airplanes increases from 19.9 percent of the respondents with the level of gasoline prices at the time of the survey to 23.9 percent with gasoline at $2.00 per gallon. At current gasoline price levels, 2 percent of the respondents use trains for vacation travel, according to survey results. This figure increases to 3.3 percent as the price of gasoline increases to $2.00 per gallon. Somewhat surprisingly, data in Table 3 shows no increase in the percentage of respondents utilizing the bus for vacation travel as the fuel prices increase to the $2.00 per gallon level. These results confirm the contention that public transportation modes will receive only modest increases in use as fuel prices increase with respondents preferring to cancel plans rather than to adopt alternative modes.

The questionnaire for those in the six metropolitan areas also examined the influence of higher fuel prices accompanied by a general rationing program limiting each vehicle to 40 gallons per month. The effects on mode choice for vacation travel reinforce the patterns observed in response to the price increases without a rationing program. The major differences are that the decision to cancel vacation plans is selected by a higher percentage of the respondents and that the decline in the rise of recreation vehicles is even more pronounced than the decline in automobile use. Indeed, with a rationing program and $2.00 per gallon gasoline prices the percentage of respondents using pickup campers, motor homes, and travel trailers declines to 0.0, 0.3, and 0.7 percent, respectively. These findings have special significance to the recreational vehicle industry.

Finally, the New York State study showed that a moderate percentage of respondents would utilize public transportation modes for vacations in view of recent and prospective fuel price increases and supply uncertainties. Thus, 15 percent of the respondents indicated that they used public transportation for vacations under current conditions at the time of the survey. It is important to note that the question did not indicate what percentage of these respondents would have utilized public transportation modes for vacation regardless of the energy picture. Nevertheless, the percentage suggesting they would use public transportation for vacations increased to 22 percent under a situation of $1.50 gasoline prices and the separate situation of a 20 percent shortfall. These percentages seem to be in line with results obtained in the 1977 Nationwide Outdoor Recreation survey.

In summary, the evidence indicates that while many households may be willing to change from a large to a small compact car, or to reduce the use of recreation vehicles, the majority are not willing to sacrifice the flexibility, privacy and comfort of the individual automobile. It appears that they prefer the alternative of cancelling the trip. This trend should continue in the foreseeable future.

ANALYSIS - ACTIVITY FREQUENCY REDUCTION

In 1975, the study by Peskin and his coworkers in the upper income suburbs of Chicago observed that the gasoline shortage during the OPEC embargo caused trips to be reduced in frequency. They also observed a tendency for trips to be linked into multi-stop journeys. Expectedly, the rising price of fuel since the embargo has continued to cause many households to institute such trip modifications. This conclusion is supported by the General Population Survey which indicates that in 1977, about 47 percent of those interviewed reduced the number of their outdoor recreation trips. The geographic and socio-economic variations in the patterns of activity frequency reduction is similar to that discussed for activity space reduction. Briefly, people with higher than average reduced participation rates tend to be males, generally between 25-44 years of age, with a family income of $15,000 or less, and with less than 13 years of education. Furthermore, they tend to be craftsmen (operatives), farmers, service-laborers and housewives. Geographically, they reside in rural areas, and tend to be non-white.

Some idea of intended reductions in the frequency of outdoor recreation activity can be interpolated from the responses given by the sample population in the General Population Survey to the following question: "If the price of gasoline doubled within the next six months, would this be likely to limit ot curtail the number of trips you might take by automobile for outdoor recreation activities?" Overall, 80 percent said they would. For all regions and socio-economic groups, at least 65 percent said they would either limit or curtail the frequency of trips; an increase of 32 percent over the situation in 1977. These changes are also evident from the Federal Estate Survey.

The survey of individuals in the six major metropolitan areas also establishes the rather dramatic effects that additional, substantial fuel price increases by themselves or combined with an overall rationing program will have on the frequency of vacation/recreation travel. Table 3 revealed that among respondents who had vacation plans, if fuel prices remained at the existing levels (Spring 1979), approximately 15 percent said they would not cancel those plans if fuel prices rose to $1.00 per gallon. The matching percentages in the face of fuel prices at $1.25 per gallon and $2.00 per gallon were 32.7 and 48.4, respectively.

The combination of higher fuel prices and a rationing program would produce even more dramatic effects on travel decisions. Indeed, with the introduction of a rationing program and no change in fuel price levels, 20 percent of the respondents would cancel their vacation plans. As fuel prices increase to a level of $1.25 per gallon and $2.00 per gallon, the corresponding percentages increase to 44.4 and 55.5, respectively. Indeed, under a general rationing program, individuals noted a preference for using their fuel supplies for work travel rather than saving them for vacations. Over 63 percent of the respondents said they would utilize their supplies for work travel rather than for recreation travel, while only 28 percent said they would not use their limited supply in that fashion. Unfortunately, the survey did not question respondents about the existence of alternatives for using their limited supplies for the journey to work. We might hypothesize that a higher percentage of those with alternatives would save fuel for recreation travels than of those with no alternatives.

The New York State survey revealed that 16 percent of the respondents said that cancellations of vacation plans was one change they had made in response to the fuel price increases during 1979. The percentage indicating that they would cancel vacation plans remained at 16 percent in the event of fuel prices at $1.50 per gallon and increased to only 18 percent in the event of a 20 percent supply reduction.

Again, these results differ somewhat from those presented in the six metropolitan area survey. Indeed, the percentage noting an intention to cancel vacation plans in New York State is quite a bit lower than the percentage of respondents in the six metropolitan areas giving such an indication. Yet, between the Spring of 1979 (when the six major metropolitan area survey was taken) and October of 1979, $1.00 per gallon fuel prices became a reality. As a result, in October 1979, $1.50 gasoline prices did not seem as drastic as they might have in May 1979. Indeed, the differences may reflect the general tendency for households to be more likely to indicate changes in response to hypothetical higher gasoline prices than to actually make those changes when the higher prices become a reality. In addition, the differences may be due to the differences between New York State residents and those in the six metropolitan areas.

The above discussion indicates that we would expect, with future increases in the price of gasoline and/or with the adoption of rationing programs, that activity frequency reduction would continue, although the specific magnitude of the reduction has not been definitively established. In many urban areas, such reductions may necessitate more pressure on urban forest resources and urban neighborhood parks.

ANALYSIS - ACTIVITY TYPE CHANGE

Activity substitution usually occurs either because of changes in the life cycle or because of economic factors such as cost of the equipment, cost of transportation and cost of participation. It can also occur because of changes in occupation or residential relocation. For the topic under study, cost of transportation, which directly impacts on other costs, is the primary consideration. Because of the increasing gasoline prices, we expect an increase in the number of people who have changed their outdoor recreation activity set. However, very little data are available on this very important topic. The following paragraphs summarize some of the facts that have been established.

Table 4 presents data from the National Travel Surveys regarding mode selected for outdoor recreation in 1972 and 1977. The data indicate that a substantially lower percentage of such trips involved an auto/truck with camping equipment in 1977 than in 1972. This mode accounted for 30.09 percent of the trips in 1972, but only 17.85 in 1977 - a decline of 12.24 percentage points The decline in significance of the auto/truck mode with camping equipment, largely offset in the growth of the auto/truck mode without camping equipment, might be explained in part by the increasing importance of shorter trips for outdoor recreation in 1977 over 1972. Perhaps, with reduced trip distance there was a lessened tendency to bring camping equipment along. Unfortunately, more definitive statements about the significance of these findings concerning changing types of recreation activities is impossible given the data limitations.

A second fact concerning changing types of recreation activities in response to higher fuel prices/uncertain supplies is the decline in recreation vehicle sales in response to dramatic shifts in the price/availability picture. Thus, in the immediate post-embargo days, the sale of recreation vehicles fell by 40 percent (1972 vs. 1974 sales). Although sales gradually increased in 1974/1975, it was not until 1976 that they reached pre-embargo levels. The same shock waves hit the industry during the early part of 1979 as fuel prices increased sharply and spot shortages developed. Sales plummented 50 percent in 1979 over the 1978 period.[3] Although there are projections of slight sales increases during 1980, it appears that the rebound process will be slow and dependent upon the avoidance of additional shock waves.

Yet, this scant data does not directly address the important question of how individuals have changed their activity patterns in response to recent events. This remains a major research gap as yet unaddressed in the existing literature.

CONCLUSIONS

During the 1970's, the nation faced two traumatic experiences with respect to fuel prices and availability. First, during the Fall of 1973 and Winter of 1974 in the aftermath of the Arab oil embargo, gasoline prices nearly doubled and lines developed as significant supply shortfalls occurred. Then, during the Spring and Summer of 1979, after four years of relatively minor price increases and limited supply problems, gasoline prices increased by at least 35 cents per gallon and supply shortfalls of 20 percent occurred in some areas. By utilizing available data sources, we have attempted to construct a picture of adjustment patterns in vacation/recreation travel with respect to both past and prospective fuel price/availability developments.

---

[3] [illegible] sales and [illegible]: "Marketing Report," Recreation Vehicle Industry Association, Chantilly, Va., 1979. Mr. W.R. Garpow provided a copy of [illegible]. His [illegible] the recreation vehicle industry were also most informative.

As summarized in Table 5, the four adjustment packages discussed in this paper have been and would be used in varying degrees. The most significant adjustments would be in the activity space reduction. An important component of these changes would be the gradual emergence of strong regional outdoor recreation centers resulting in the replacement of the present three-tier hierarchy (national, regional, and local recreation centers) by a two-tier hierarchy (regional and local recreation centers). In this process, the forest resources around large metropolitan areas would be in increasing demand.

As noted, data from existing surveys give a clear indication that there has been only a slight to moderate shift to various forms of public transportation for recreation travel. Yet, the data suggest that lower income households as well as younger individuals are willing to utilize public transportation for vacation/recreation travel. Unfortunately, affordable public transportation is generally not available to recreation sites. Thus, growth in public transportation among these population segments may be a function of government programs to provide energy-efficient forms of low-cost public transportation -- primarily bus transportation -- to increasingly more popular recreation sites in proximity to major metropolitan areas.

Also, prospects for recreation vehicles are not bright in the immediate future. Sharp fuel price increases coupled with supply interruptions have severely affected recreation vehicle sales. Long-term prospects for recreation vehicles are dependent upon improvements in their fuel efficiencies or changes in their use by households. For example, households may leave the vehicles in proximity to recreation sites and utilize their more fuel-efficient autos to travel to their recreation vehicles. This contrasts sharply with the current practice of driving the recreation vehicle from origin to destination. Such a practice would also limit the household to a specific recreation site. Other expected changes are summarized in Table 5.

The ability to forecast trends in recreation/vacation travel in response to higher fuel prices and/or supply uncertainties is hampered by limited data sources. Although certain trends emerge, many questions are left unanswered. Thus, survey respondents have been consistently stating that their vacation/recreation trip distances are decreases in response to fuel price increases. Indeed, the Census of Transportation showed that a substantially higher percentage of the recreation trips in 1977 than in 1972 were for shorter distances. Yet, the data give no picture of the specifics of the shorter trips. Are households focusing their recreation/vacation trips on regional/metropolitan sites exclusively? Alternatively, are they eliminating only the yearly trip to a national site, but traveling the same amount during the rest of the year? Do the changes in distance traveled for vacation/recreation travel mean a change in activities engaged in as well?

At present, although data sources have provided us with some basic information on trip distances, trip frequencies, and mode choice they do not enable us to answer the above questions. Yet, effective recreation planning during the 1980's requires answers to such detailed questions. To adequately answer such inquiries, data needs to be gathered about vacation patterns over time from the same households. In the absence of such detailed information, many of the planning assumptions and resource allocations may be inappropriate.

Americans place a high value on outdoor recreation. Results from the 1977 Nationwide Outdoor Recreation Survey showed that 57 percent of the respondents viewed outdoor recreation as very important while an additional 29 percent viewed it as somewhat important. However, the increases in fuel prices coupled with supply uncertainties that have occurred during the 1970's have strained the traditional vacation patterns of many American households. Alleviation or mitigation of such strains requires effective planning based upon data that is currently not available. Until such data gaps are closed, existing sources must be utilized to the extent possible to give indications of likely responses to continued fuel price increases and supply uncertainties.

Mr. Dana Younger, Outdoor Recreation Planner, Division of Nationwide Recreation Planning is greatly appreciated for his assistance.

LITERATURE CITED

Burke, James F. and Williams, Peter W. 1979. Gasoline Prices and Availability: What Do They Mean for Tourism? Utah Tourism and Recreation Review. 8: 1-8.

Corsi, Thomas M. and Harvey, Milton E. 1979. Changes in Vacation Travel in Response to Motor Fuel Shortages in Higher Prices. Journal of Travel Research. 17: 7-11.

Corsi, Thomas M. and Harvey, Milton E. 1978. Toward a Casual Model to Explain Differing Household Vacation Patterns as a Result of Higher Fuel Prices. Journal of Leisure Research. 10: 298-310.

Peskin, Robert L. et. al. 1975. The Immediate Impact of Gasoline Shortages on Urban Travel Behavior. Urban Planning Division, Federal Highway Administration, U.S. Department of Transportation, DOT-FH-8500.

U.S. Bureau of the Census, Census of Transportation, 1972. 1973. National Travel Survey (Volume 1). U.S. Government Printing Office, Washington, D.C.

U.S. Bureau of the Census, Census of Transportation, 1977. 1979. National Travel Survey (Volume 1). U.S. Government Printing Office, Washington, D.C.

U.S. Department of the Interior, Heritage Conservation and Recreation Service, 1980. Third Nationwide Outdoor Recreation Plan. An Assessment of Outdoor Recreation (Volume 2) and Appendix I: Nationwide Outdoor Recreation Survey Summary (Volume 3) and Appendix II: Nationwide Outdoor Recreation Survey Technical Reports (Volume 4). U.S. Government Printing Office, Washington, D.C.

Table 1.--Outdoor Recreation Trips, Distance Traveled, 1972 vs. 1977.

Round Trip Distance	% of Trips 1972	1977	Difference 77 vs 72
200 to 399 mi.	47.80	60.40	+12.60
400 to 599 mi.	20.99	17.56	-3.43
600 to 799 mi.	10.60	6.23	-4.37
800 to 899 mi.	4.84	2.82	-2.02
1,000 to 1,999 mi.	6.82	5.35	-1.47
2,000 mi. and above	4.31	3.86	-0.45
Outside U.S.	4.64	3.78	-0.86

Source: U.S. Bureau of Census, 1977, 1979.

[illegible] Between [illegible] Levels/Supply Restriction Programs

[illegible] Major Metropolitan Area Survey.

Travel Distance*	Price Levels/Supply Restriction Programs Current Pricing	$1.00/ gallon	$1.25/ gallon	$1.50/ gallon	$2.00/ gallon	[illegible] vehicle/ month	[illegible] Available on Weekend
Less than 100 mi.	8.6**	8.5	7.6	8.5	12.1	11.2	13.4
100 - 249 mi.	9.5	12.9	8.9	6.7	7.1	9.4	9.4
250 - 499 mi.	21.3	18.8	16.1	13.4	10.7	13.8	12.5
500 - 999 mi.	18.1	17.0	14.7	9.4	6.7	8.0	7.2
1000 - 1499 mi.	12.7	10.7	6.3	4.9	2.7	3.6	4.0
1500 - 1999 mi.	8.6	7.2	4.0	1.3	1.8	1.8	3.1
2000 - 2999 mi.	11.3	8.9	3.1	1.3	1.3	2.2	2.7
3000+ mi.	9.9	8.0	6.0	3.6	2.7	2.2	2.2
Won't Travel	0.0	8.0	33.3	50.9	54.9	47.8	45.5

*Only respondents who had travel plans at time of the survey were included.

**Numbers indicate percent of households responding in the given categories.

Source: Burke and Williams, 1979.

Table 3.--Relationship Between Fuel Price Levels and Mode Choice for Vacation Travel - Major Metropolitan Areas Survey.

Mode Choice*	Fuel Price Current Levels	$1.00/ Gallon	$1.25/ Gallon	$1.50/ [illegible]	$2.00/ Gallon
Automobile	60.5**	48.4	31.4	20.4	16.2
Pickup Camper	4.9	4.6	1.3	1.3	1.0
Motor Home	4.2	3.9	2.9	1.3	1.3
Travel Trailer	5.2	4.6	2.6	1.6	1.3
[illegible]	1.0	1.9	2.0	2.3	2.3
[illegible]	19.9	18.3	21.9	23.5	23.9
[illegible]	2.3	1.3	2.3	2.6	2.3
Train	2.0	2.3	2.9	[illegible]	3.3
No Travel	0.0	14.7	32.7	44.1	48.4

*Only respondents who had travel plans at time of the survey were included.

**Numbers indicate percent of households responding in the given categories

Source: Burke and Williams, 1979.

Table 4.--Outdoor Recreation Trips, Mode Selected, 1972 vs. 1977.

	% of Trips		
Mode of Transportation	1972	1977*	Difference 1977 vs. 72
Auto Truck w/o Camping Equip.	63.96	73.31	+9.35
Auto/Truck w Camping Equip.	30.09	17.85	-12.24
Bus	1.82	3.59	+1.77
Train	0.10	0.21	+0.11
Airplane	3.17	3.93	+0.76
Other	0.86	1.11	+0.25

*In 1977 trips in which different modes were used going and coming were categorized separately. This procedure was not utilized in 1972. As a result, for comparability, such trips were excluded from tabular presentation

Source: U.S. Bureau of Census, 1977, 1979

Table 5.--Gasoline Prices/Availability and Outdoor Recreation Activities - The Future.

Type of Adjustment Package	Attribute	Present	Future
1. Activity Space Reduction:	Shape	Shrinking	Optimal Compact Shape
	Tendency	Intervening Opportunities	Distance Decay
	General Pattern	National/Regional Sites	Regional/Local Sites
	Mode Efficiency	Increasing Importance of Fuel-Efficient Cars	Further Increases in Fuel-Efficient Cars/Technological Breakthroughs
2. Activity Mode Change:	Bus	Trace	Moderate Increase, Primarily Among Lower-Income Households
	Carpooling	Slight Increase	Some Appreciable Increase
	Train	Trace	Trace
	Air	Slight Increase	Moderate Increase, Restricted to Higher-Income Households
	Recreation Vehicles	Decline	Further Declines
3. Activity Frequency Reduction:	Periodicity	Decrease	Further Decrease
	Duration of Activity	Slight Change	Increase
	Multi-Stop Trips	Increasing	More Future Increases
4. Activity Type Change:	Rate	Increasing	More Future Increases
	Tendency	Determined by Interest	Partly Determined by Availability Nearby

TRENDS IN STATE OUTDOOR RECREATION FROM PERIODIC TO PROCESS PLANNING: THE MINNESOTA EXAMPLE[1]

William H. Becker and George Orning[2]

After a decade of trial, a change in ederal planning philosophy is forcing many tate recreation planning programs to hange. Ten years of experience showed hat plans produced periodically -- every ive years -- grew stale and failed to rovide the flexibility necessary to meet hanging recreation markets and environental problems. Recognizing these roblems, the Heritage Conservation and ecreation Service redrafted its planning uidelines to encourage ongoing planning rocesses, rather than static plans. This hift in emphasis, designed to give states he flexibility necessary to coordinate ffective expenditures of Land and Water onservation Fund (LAWCON) dollars, has equired changes in the ways many states ischarge their comprehensive recreation lanning duties.

Under the periodic planning approach, tates could receive up to five years' ligibility to use LAWCON funds. As new lans became due, states would reassess the ublic's rate of participation in outdoor ecreation activities, reinventory the xisting recreation facilities, seek public nput on recreation issues, and determine cquisition and development needs for the ext five years of action. Budgets and taff for recreation planning expanded and ontracted on a five-year cycle like ccordions.

In the ebb of the cycle, little staff ower existed for data analysis and direcion, channels of public involvement losed, and data and proposed actions grew tale. At the height of the cycle, staff ime was occupied by the intense demands of omprehending and communicating the ublic's perceived needs for the next five ears. In short, the periodic approach roduced plans, but moved planners away rom a role as continuous advisors to ecision-makers.

The process approach seeks to level this cycle. By so doing, the planning staffs should be available to listen to concerned citizens, monitor resource acquisitions and development, give advice on fast-breaking issues, participation trends, maintain current inventories on recreation facility supplies and, most importantly, help decision-makers on a continuous basis.

Unfortunately, unless planners redesign their approach to planning, Process Planning will require a constant amount of budget and staff equivalent to the height of the five-year cycle. Only E. H. Porter's Pollyanna could foresee public financial support for a new cadre of permanent planners in state bureaucracies. Therefore, for Process Planning to come to fruition in state outdoor recreation planning, every possible economy must be used.

The primary economy possible is increasing efficiency in data collection and avoiding large-scale data collection for planning purposes that are not part of ongoing agency operations. This will free time for a more active role by planners in day-to-day decision-making.

Though the specific methods of implementation may differ from state to state, the general areas in which to look for economy hold true across all states: these areas are in the collection of resource, facility and user data, and in the collection of public input. Data inventories need to be collected on a continuous basis, must be computerized, and must be tied to the ongoing record keeping functions of state agencies and to the courthouse records of local governments. Public input processes must be designed as part of the ongoing input into more comprehensive decision structures such as state agency long-range plans, legislative committee processes and regional plans. With the shift to process planning, efficiency in data delivery becomes important. A publication format that accommodates continuous revision must be developed. States must develop and implement computerized management information systems that can quickly process planning data for day-to-day decision-making. But last and most important, states must train, employ and retain qualified staff, who will move toward a data liaison and a consulting role.

---

[1] Paper presented at the National Outdoor Recreation Trends Symposium, Durham NH, April 20-23, 1980.

[2] Supervisor, Research Unit, and Manager, Research and Policy Section, Minnesota Department of Natural Resource, St. Paul, Minn.

EFFICIENCY IN RESOURCE DATA COLLECTION

The essence of economical information gathering is the use of secondary sources and ongoing, in-place data input channels.

Many secondary sources exist for resource data: state as well as U.S. Forest Service inventories of vegetative cover, Soil Conservation Service Soils Surveys and U.S. Geological Survey maps all provide ready data sets for planners. If the recreation planner can locate a central, preferably computerized, clearinghouse for these data, the bulk of resource data collection is complete. In Minnesota, the State Planning Agency operates just such a clearinghouse, the Land Management Information Center (LMIC). LMIC stores resource data on a computerized grid system tied to the land survey and courthouse records, allowing data mapping and the creation of new, more useful variables from the original data set. For example, if we want to produce a map of scenically attractive areas using Minnesota's topography, forest cover and nearness to water as independent variables, we can. All we must do is decide the data classes, determine proper scale and design map symbols and patterns for automated map production. Figure 1 shows a scenically attractive area map produced in just this way.

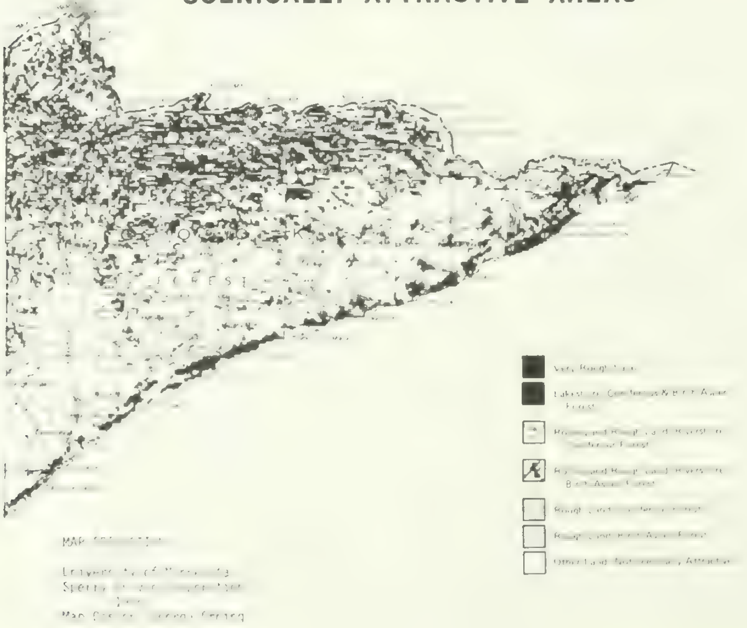
In addition to the more traditional resource data listed above, the Minnesota Department of Natural Resource has created a public land ownership data set that is LMIC system compatible. Unlike physical resource data, this cultural data changes often and must be continuously updated. Here is where ongoing, in-place channels of communication come into play. By redirecting the land ownership paper shuffle to include a key-punching step, land ownership records can be continuously updated. Thus, with minimal extra effort, quality data is maintained on an ongoing basis.

If the situation dictates, other types of data can be added to the system. For example, if mineral leasing in Minnesota accelerates to the point that it might threaten recreation options, mineral leasing records will be added to the system.

The state recreation planner, shifting from periodic to process planning, will be hard pressed to find a good secondary facility data source. In fact, state

Figure One

SCENICALLY ATTRACTIVE AREAS



recreation planning staffs usually keep the primary data set. The key to economy here is making sure the primary data set keeps pace with changes in the facility makeup. Keeping pace eliminates the need for massive, costly reinventories. Again, ongoing, in-place systems provide the efficient mechanism for updating facility data.

By tapping field facility inventories and expenditure records, facility can be kept up to date. In Minnesota, for example, the Division of Parks and Recreation and the Commissioner's special Trails and Waterways Unit have operations sections that administer LAWCON and matching state funds and acquire, develop and manage these facilities. These field people know where the state-owned facilities are located, when a new facility is built and when an old facility is abandoned. Figure two shows a validation form now being developed for the continuous inventory of the public access program.

Local LAWCON recreation funding programs may also be tapped for continuous data input. By plugging into the LAWCON paper work, continuous updating of a major portion of the facility data is achieved. Other recreation funding programs can also provide data. For example, in Minnesota many miles of recreational trail are annually added through the Grant-in-Aid Trail Program. The records of funded Grant-in-Aid trails are now funneled to the SCORP inventory for updating purposes, and are used as the official records of the trails operation unit. In addition, the computer mapping capability will be used to publish trail maps for public information.

Collecting facility data from private and federal sectors poses more problems because their development and acquisition programs lie outside direct state control. Therefore, facility inventory systems should be designed to expedite updating the private and federal sectors through mailed questionnaires and interagency agreements. In Minnesota the facility information is programmed to produce custom questionnaires for the administrator/owner of each inventoried facility, showing what we currently record as their facilities. When the private sector's mailing list is updated through public health records, a complete survey is easily produced on a biennial basis. Finally because only changes to the data base are entered, the workload is reduced substantially.

EFFICIENCY IN USER DATA COLLECTION AND PUBLIC INPUT

User data is an area where many record keeping systems exist for the most important recreation activities. By redesigning systems for hunting, fishing and boat licenses and for park camping permits, user populations do not need to be surveyed as often. The flow of licenses becomes a continuous flow of user information. A few simple questions added to each license or permit application yield significant dividends for planning and management. For example, the current SCORP work program in Minnesota includes adding to boat license applications questions on what lakes and lake areas are most often used by boaters. By continuously monitoring the distribution of summer water use we can better predict changes in boating patterns and utilize this information in our planning efforts.

Many recreation activities are free of licenses or permits; but in general these activities each hold only a small share of the recreation market. Where this is not the case, special data collection efforts should be undertaken. By narrowing the objectives of these investigations cost can be held to a minimum.

In the shift from periodic to process planning, public input can increase the workload and attendant expenses. If the process planner is dedicated to addressing fast-breaking issues and problems, personally meeting with the proper public to gain their advice will overburden and threaten the effectiveness of a small staff. However, the democratic process is founded on public input. As a result, many ongoing, in-place public input mechanisms can be tapped. In Minnesota the recreation planning staff does not hold many public meetings to gain public input. Instead, potential actions are reviewed through existing public forums. These include the Regional Development Commissions, each of which is charged with developing a comprehensive regional plan, the Legislative Commission on Minnesota Resources, which is a bi-partisan body made up of key legislators specializing in natural resource issues, and the Outdoor Recreation Advisory Committee, which represents elected local government officials from each development region.

Public input through existing forums is used on the primary yearly component of SCORP - The Annual Action Program. We deliver a draft to the legislature prior to the appropriations session. It is made available as one of the primary information sources legislators use to understand what public good recreation expenditures are supposed to accomplish. Reviewing the draft with constituents provides public input on upcoming recreation acquisition and development. When the legislators actually appropriate dollars to carry out the action plan, they assure that planned actions will be realized.

During the course of legislative debate, advice and support are provided by Regional Commissions which have reviewed the draft action plan with local units of government and interested citizens in their regions. In addition, the Outdoor Recreation Advisory Committee provides input from the perspective of regional policy makers.

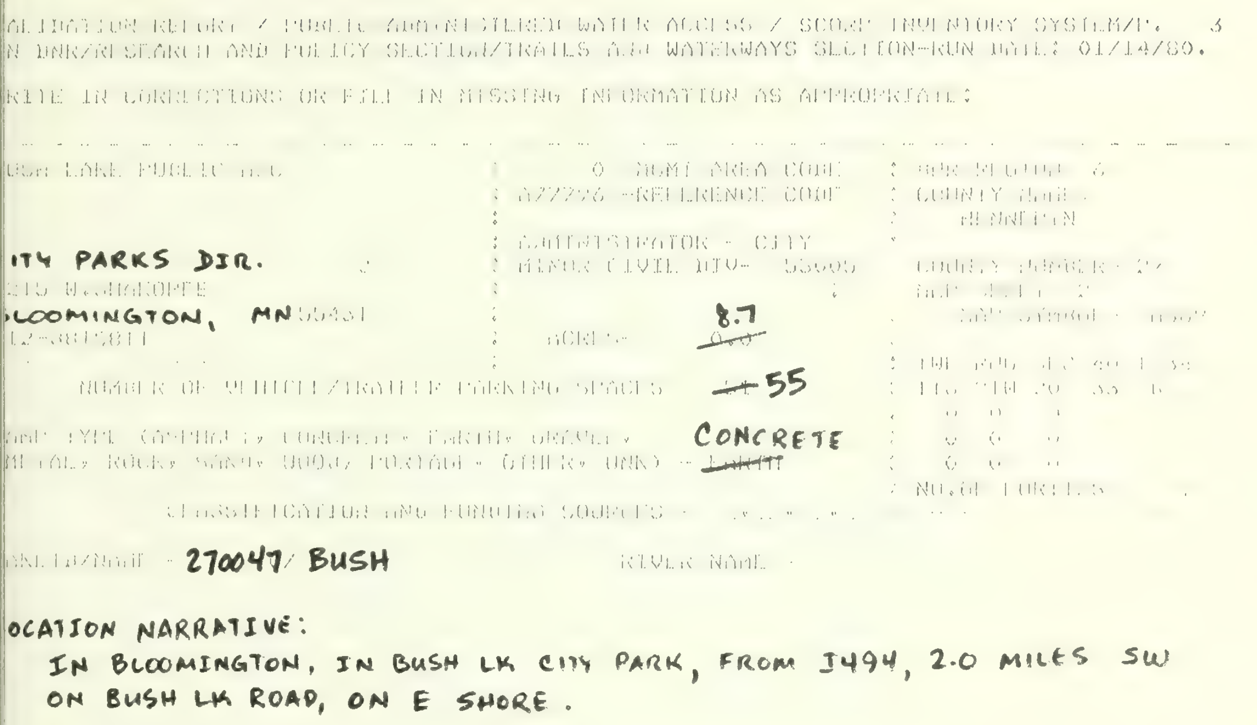
Finally, the state recreation planning staff is available to answer specific questions and give advice on recreation issues to legislators and local government officials.

EFFICIENCY IN DATA DELIVERY

The change from periodic to process planning not only provides for more flexibility but also demands more efficiency. In data delivery flexibility means efficiency. The process approach, with its dynamic data base, makes expensive printed data volumes less important. Meeting requirements of efficient, flexible planning necessitates a change in the format of State Comprehensive Outdoor Recreation Plans from typeset, bound, professionally printed reports to loose leaf data sets. The planning staff then can systematically update the areas of the plan where change occurs quickly. This approach assures that SCORP is continually current.

Distribution of a SCORP Report Series efficiently provides raw data and maps for state, regional and local planning efforts and for analysis of current issues. SCORP Report Series maps are provided at the state level: one example is a state map of public land ownership. Also, each Regional Development Commission has been supplied with an atlas map series to be used as an aid by them in development of their comprehensive regional plans. The raw data reports provide information such as region-to-region recreation occasion flows and detailed responses from specialized surveys.

Efficient planning must include the development of state recreation planning staff capable of assisting all planners in the state concerned with recreation. This liason role is vital to carrying the process planning approach to the local levels, where much of the recreation facility provision takes place. Staff must have the ability to clearly explain the process approach. They must be able to sort through ideas provided by recreation planners, understand their objectives and the problems they confront, and propose solutions. Finally, they must be able to direct planners in utilizing the wide-ranging set of computerized data, analyzing it and drawing conclusions. In short, for the process planning approach to succeed, state planning staffs must attain a high level of competence in research and analysis of recreation-related data, and be able to utilize the latest computer modeling and mapping techniques.



ALIDATION REPORT / PUBLIC [illegible] WATER ACCESS / SCORP INVENTORY SYSTEM/P. 3
N DNR/RESEARCH AND POLICY SECTION/TRAILS AND WATERWAYS SECTION-RUN DATE: 01/14/80.

RITE IN CORRECTIONS OR FILL IN MISSING INFORMATION AS APPROPRIATE:

USH LAKE PUBLIC [illegible] : 0 MGMT AREA CODE : [illegible] REGION 6
: A77296 -REFERENCE CODE : COUNTY NAME -
: HENNEPIN
: ADMINISTRATOR - CITY
ITY PARKS DIR. : MINOR CIVIL DIV- 55005 COUNTY NUMBER - 27
[illegible] : [illegible]
LOOMINGTON, MN 55431 : [illegible]
12-8817811 : ACRES- 8.7 ~~0.0~~

NUMBER OF VEHICLE/TRAILER PARKING SPACES ~~11~~ 55 : [illegible]

AMP TYPE (CONCRETE, CORRUGATED, EARTH, GRAVEL, CONCRETE : [illegible]
METAL, ROCK, SAND, WOOD, PORTAGE , OTHER, UNK) - ~~EARTH~~ : [illegible]
: NO.OF TOILETS [illegible]

CLASSIFICATION AND FUNDING SOURCES - [illegible]

AKE ID/NAME - 270047/ BUSH RIVER NAME -

OCATION NARRATIVE:
IN BLOOMINGTON, IN BUSH LK CITY PARK, FROM I494, 2.0 MILES SW ON BUSH LK ROAD, ON E SHORE.

Figure 2.--Validation report. *Examples of forms sent to field:* This validation report is intended to be mailed to the field where it is reviewed and, if needed, corrected. Corrections are written directly on the validation form by field personnel. The returned form is then used to enter corrected data into the computer. The entry is made directly to the data base through an on-line connection or by batch processing.

TRENDS IN LAND AND WATER AVAILABLE FOR OUTDOOR RECREATION

LLOYD C. IRLAND
Maine Bureau of Public Lands

THOMAS RUMPF
Maine Forest Service

Maine Department of Conservation
State House, Station #22
Augusta, Maine 04333
(207) 289-3061

Abstract.--A data base for assessing the availability of land for outdoor recreation does not exist. Information on related issues such as vandalism, easements, and land posting is scanty. Construction of a data base for assessing land availability should be a high priority for USFS and HCRS, and for SCORP's and the RPA and RCA assessments.

Outdoor recreation is by definition a land-using activity. The intensity of use may vary from a few visitors per acre per year in the far corners of the North Cascades to thousands per acre per year at Coney Island. It is of obvious interest, then, to review the current and likely future trends in land available for outdoor recreation. Completeness requires that land and water be considered together.

In this paper we outline the problems that must be considered in assessing and influencing recreational land availability in local areas.

To define the availability of land for outdoor recreation, we must classify land acreage by the following variables:

1. Physical characteristics (ponds, beaches, rapids, mountains)
2. Ownership (state, federal, private)
3. Management policies of the owners
4. Requirements of the activity
5. Accessibility - boat ramps, rights of way, roads, fencing.

No data base of this sort now exists. Creating such a data base should be one of the principal concerns of HCRS research, the SCORP process, and the U.S. Forest Service and Soil Conservation resource inventory and assessment processes now underway.

In this paper, we summarize bits of existing data to suggest how the problem may more fruitfully be studied. We think that our review leads to important policy implications. In searching for raw material, we queried administrators in state agencies responsible for parks, wildlife, and forestry, and federal land managing agencies. We received many helpful responses. We also reviewed a hefty sampling of recent state SCORPs. The written record reflects that inadequate attention is being devoted to the strategic long-term issues which we were asked to discuss here.[1] We suspect that much of the research and inventory activity addressing land supply and access is not well documented yet.

We make no effort to construct a new data base for this paper. Instead, we review the broad background trends in land ownership that affect recreation. We then discuss the problems of defining effective access to land for recreation and some of the factors that determine effective access. Finally, we note four major policy issues: should public subsidies be tied to access policies?; what is the future role of government in providing land for recreation?; how can the private sector role be promoted?; and, what are the issues in land acquisition?

MAJOR TRENDS

To characterize the major economic trends affecting the availability of land and water for recreation is perhaps more useful than attempting to add up all the numbers. General data are shown Table 1. Major forces at work in the past quarter century include:

-- The reversal of rural out-migration and revived settlement and construction in remote regions. This revival includes residential settlement, which directly changes land use and often produces posting. A far greater acreage, however, has been affected by speculative "recreational subdivisions" catering to speculators and well-to-do urbanites. Such developments now cover millions of acres of rural land, often blocking access to water and to major public reservations as well (U.S. CEQ, 1976; Payne, Gannon & Irland, 1975). Development trends on our nation's coasts have led coastal zone planners to identify public access to the coast as a prime policy issue.

[illegible]
(Million Acres)

			1972		
National Forests	181	--	--	[illegible]	[illegible]
National Parks	23.3	--	--	29.6	[illegible]
State Park & Recreation Areas	--	5.6	—	9.8	[illegible]
Municipal & County [illegible]	0.6	--	1.7		[illegible]
Wilderness	14.0 (1945)*	--	31.2		[illegible]

* [illegible]

[illegible] U.S. Government Printing Office, Washington D.C.

-- The significant growth in acreage devoted to recreation through increased public ownership and leasing.

-- The growth in recreation activities which produce substantial disamenity has expanded some recreational opportunities and reduced others. Few lakes and forests are now havens for peaceable strolling, out of range of the noise of trailbikes, waterskiers and snowmobilers.

-- Sizable regions, on the other hand, have been devoted to back country activities, often with motorized and developed opportunities excluded. The potential exclusion of motorized activity has often been the most loudly contested question in wilderness area debates. Our informal survey found that a number of states have established wilderness areas on state-owned lands.[2]

---

[1] In preparing this paper, we have found virtually no trend material on vandalism, other than the Alfano and Magill (1976) Symposium. We suggest that state and federal crime statistics, and the USFS RIM system, might be worth searching for this purpose. We also do not treat specialized issues regarding access to federal lands, such as range land fencing and coal development in the west.

- -- Public agencies and private groups have made major progress in maintaining public access through agreements with landowners--acquiring easements, leasing and similar measures. The classic example, of course, is the Appalachian Trail (Burch, 1979). Snowmobiling, Hunting and fishing have also been, major areas of activity. Such steps have not yet been, it appears to us, widely applied to nongame wildlife, day hiking and cross-country skiing.
- -- Private enterprises have expanded the supply of many recreation opportunities, including camping, boat access and services, lodging and in other traditional fields. Other specialized activities such as trout farms, cross-country ski areas, and the like have as yet not achieved a large role in their respective fields. Much more could be done to apply the capabilities of private enterprises to recreation supply.
- -- Recreation developments requiring massive construction now face declining prospects for acceptance in the nation's high mountains and in vulnerable coastal areas. These developments usually serve high income clienteles, cause major local social disruption and can cause significant environmental impact. The prospects for increasing numbers of such developments in the next few decades are low. (Anon.,1975).

DEFINING EFFECTIVE ACCESS

In many respects, comprehensive data on land ownership, were it available, would not tell the true story about the availability of lands and waters for recreational use. The total supply available is not the most important factor controlling public availability. We need to define "effective access" with respect to each land and water unit.

A comparable problem has been faced by timber resource survey experts in estimating the supply of privately held timber available for harvest. Methods used in that field should be reviewed for applicability to assessing effective access for recreation.

Effective access is controlled primarily by the ability of recreationists to "get there." A unit of land or water is of little recreational value if the public is unable to get to it in the first place. In many areas, particularly in larger public and private holdings, effective access has been significantly increased since World War II through accelerated private and public road building programs.

As an example, the large private landholdings which constitute the major portion of the northern half of the State of Maine, were accessible only by float plane and/or canoe prior to World War II. Since that time, this area has become laced with a comprehensive network of private woods roads, open to the public on a regulated basis. In the future, road building will continue to open up more areas to recreation, but at a declining rate. According to some, of course, this increased access is a trend for the worse, since it adds to fishing and hunting pressure and reduces the wilderness atmosphere.

Closely linked to the impact of road building into previously unroaded areas, is the changing technology of recreational transportation. The use of snowmobiles and other off-road vehicles (ORV's) in conjunction with expanding road systems has opened up many areas previously limited in access. Increasing fuel costs will most likely stabilize the use of this access tool in the future.

---

[2] Examples culled from our survey of the States: Hawaii, 93,000A. of Natural areas; W. Virginia, "several areas"; Massachusetts, 4 areas; Michigan, 53,000A; Pennsylvania, 224,000A of primitive and wild areas; Maine, 20,000 acres in Allagash Wilderness Waterway plus 200,000A of trust lands in Baxter State Park.

Effective access may be limited in the more traditional physical sense as well. Lack of boat ramps can close off otherwise "public" waters. Strip development along roadways has effectively closed off large blocks of public and private land since World War II. This trend is likely to continue into the future in areas of high population density and economic growth.

Conflicts between mutually exclusive recreation user groups can effectively limit accessibility on a unit of land or water for a given recreational user. User group conflicts have escalated considerably since World War II and will continue to intensify (Bryan, 1979). In the future these conflicts can be most effectively reduced by zoning recreational lands to separate conflicting users either in time or in space. This technique will not eliminate the problem completely, and user group conflicts will continue. In Maine, improved cooperation betwee x-c skiers and snowmobilers is reported. Such cooperation should be encouraged.

In many parts of the country, a traditional package of social, cultural and historical use of lands and waters may effectively preclude exclusion from private ownerships. This phenomenon serves to highlight the dichotomy between the explicit and implicit availability of lands and waters. Explicit availability is determined by specific legal provisions for accessibility. The most common approach for obtaining explicit availability is through public ownership. Implicit availability, on the other hand, usually does not stem from any legal provisions, but rather from historical patterns of use. For example, the woods of northern Maine have been used by residents for hunting and fishing for generations, despite the fact that they are almost entirely privately owned, and accessible only by private roads. Efforts by some owners to regulate access to these lands in the last 10 years have met with strong resistance from local residents (For case studies, see Hengsbach, 1970; Stewart, 1963).

In some cases, implicit availability may be incorporated into provisions of state law, as with the various Great Ponds Acts common in New England, which were enacted in Colonial times. These laws commonly hold that on Great Ponds the public has the right to fish, fowl, cut ice, swim and boat (Smith, 1950). In some cases, this historical ordinance provides for access to Great Ponds over private land. As population pressures increase, and as community cohesion weakens in our mobile society, implicit access to private land will erode in the future.

LAND POSTING

The posting of private land against use by others has disturbed those concerned with outdoor recreation, especially hunting and fishing, for decades. The ORRRC reports on hunting and fishing in the early 60's reported that access to private land was a major future priority for expanding the supply of these activities. Yet their reports did not offer extensive analysis of alternative policies to promote such areas. (ORRRC, 1962a, 1962b). Nor, disappointingly, does the Third Nationwide Plan emphasize the issue.

Considerable private land remains open to public use. The Third Nationwide Plan estimates that 32% of the noncorporate land acreage is open to the public (217 million acres) and 54% of the corporate land is open (40 million acres). Most of the land owned by forest products companies is open to the public. In the South, acreage of forest industry land open to the public for recreation rose from 19.5 million acres in 1962 to almost 25 million acres in 1974 (Convery, 1979, p.29; Cordell and Maddock, 1969; and Patrick, 1969).

Land posting results from social change and social conflict. In the past, rural landowners in many regions accepted the right of others to cross their property for the purpose of hunting, fishing and travel. When the people doing so were neighbors, and when the owner himself expected to enjoy the same right elsewhere, a supportive social consensus favoring public access to private land could exist. Today, the users are increasingly strangers from a distance. They at times damage roads with four-wheel drive vehicles, hot-rod snowmobiles, or hunt birds in the backyards of persons who disapprove of hunting. The consensus supporting public use wrinkles. When fences are broken and buildings vandalized, it collapses. The increased development of rural regions means that residents are closer together; but even neighbors are often strangers.

Our survey of recreation agencies and perusal of SCORP's yielded little comparative data on posting trends over time. In a Michigan study comparing 1929 to 1960, a sample of Upper Peninsula counties saw land posting rise 600%, while a lower peninsula sample rose more than threefold (ORRRC, 1962b, p. 97-98). This is the only study of posting trends we were able to locate. As an example of currently available data, results of several U.S. Forest Service studies are summarized in Table 2. They display considerable variation in landowner reactions to different public uses of their land.

The importance of these landowner preferences cannot be overemphasized. A change of 10 percentage points in the proportion of owners allowing a given activity can nullify the state-wide effect of millions of dollars of outlays on land acquisition, leaving the general public no better off than before.

Posting is likely to continue to increase, based on the social trends now visible in rural America. To preserve access to land and water in the face of changing land owner attitudes will require that the major conflicts be addressed. User groups and public agencies will have to assure land owners that vandalism, littering and noise will be controlled. Owners may have to be paid for allowing recreational uses. Users will have to accept "corridoring" along designated

Table 2. Activities Permitted on Private Lands, Selected Northeastern States 1979's

Region and Item	Hunting	Fishing	Hiking	Snowmobiling	All Use	Total owners or acres
	....................percent	permitting..........				
Southern New England 1972-73 1/						
% of Owners	25	17	42	N/A	-	[illegible]
% of Land	37	30	48	N/A	2/3	4.4 million acres
New Hampshire & Vermont 1973 2/						
% of Owners	51	37	51	50	51%	[illegible]
% of Land	50	59	73	59	-	8 million acres
Kentucky 1975 3/						
% of Owners	24	6	12	1	[illegible]	[illegible]
% of Land	46	13	.22	3	52%	11 million acres
West Virginia 1975 4/						
% of Owners	49	5	37	11	60%	124,000 owners
% of Land	53	26	44	11	65%	6.7 million acres

1/ Neal P. Kingsley, The Forest-Land Owners of Southern New England. [illegible] Resource Bulletin NE-41, 1976.

2/ Neal P. Kingsley and Thomas W. Birch. The Forest-Land Owners of New Hampshire and Vermont. USDA Forest Service, Resource Bulletin NE-51, 1977.

3/ Thomas W. Birch and Douglas S. Powell. The Forest-Land Owners of Kentucky. USDA Forest Service, Resource Bulletin NE-57, 1978.

4/ Thomas W. Birch and Neal P. Kingsley. The Forest-Land Owners of West Virginia. USDA Forest Service, Resource Bulletin NE-58, 1978.

paths and corridors that avoid gardens, tree plantations and homes. These arrangements can only be made by organizations. Snowmobile groups have successfully used this approach in many states. (Nordstrom, Stephenson and Nies, 1977).

In States where citizens have enjoyed common law rights of access to seashore, to Great Ponds and to undeveloped wildland, the basis in custom exists to rebuild a consensus in support of public use and access. A possible model is the program of Public Footpaths in England, in which the public is secured the right of transit over private lands for recreation. The Footpaths are well marked and provided with occasional parking places off small rural lanes. Thus, a medieval system of public rights necessitated by the three-field system of farming and the lack of public roads has been turned into a basis for recreational use by visitors from afar. The essential rights are supported by a public consensus. (See Sidaway, 1979 for related information on trails in England)

In efforts to prevent the loss of public access through posting, most states have provided laws limiting land owner liability and otherwise promoting public access. These have been extensively reviewed by Bradley (1977), Quaterman (1975), and Strodtz and Dane (1968). These laws are probably of greater importance in reducing the anxiety level of large owners than they are in promoting public use on small ownerships.

POLICY ISSUES

Should Public Subsidies and Tax Breaks Be Tied to Public Access?

Our society offers a variety of subsidies, some trivial, some substantial, to private landowners. They range from low-cost wildlife bunches and extension pamphlets to the $15 million in public funds spent to fight the spruce budworm in Maine. We offer land owners help in cutting and planting trees, in planting cover crops, and for an impressive array of management practices, including construction of farm ponds.

Because of its political sensitivity, it is understandable that a coherent policy has never emerged concerning any obligation on the part of the beneficiaries of subsidies to allow public recreational use of the benefitting lands. We think that this issue must be addressed immediately. Where land owners benefit substantially from production or amenity - increasing public subsidies, they should be required to allow public access. There is no excuse for subsidizing timber stand improvement or cover crops on private estates closed to all public use. The task will be to design programs that protect legitimate land owner interests that are at stake, and to achieve their acceptance politically. Enforcing the access provisions will be a challenge.

An additional subsidy is use-value taxation. Should owners benefitting from lowered tax assessments be required to allow public use of the land or a portion thereof? We understand that in Michigan such a policy is in effect under that state's forest tax program, covering 1.25 million acres (Act 194, PA 1925).

Future Role of Government

The Federal Government has taken on an awesome responsibility for the nation's outdoor recreation needs. This is based on the large federal landownership, on the ease of raising revenue through federal taxes, on the multistate nature of outdoor recreation, on explicit economic development considerations and, frankly, on the unwillingness and incapacity of state and local governments to address the issue.

Specific groups have used their organizing ability to use government as a potent tool in advancing their interests. Hikers have led the fight to preserve wilderness areas and constrain the activities of ORV'rs on federal lands. Snowmobilers have worked with state programs to expand the supply of trails, and have taxed themselves to provide those services. Most successful of all, of course, have been sportsmen, whose taxes on equipment and successful lobbying are responsible for large programs of land acquisition, wildlife and fish management, and research. This is for a series of activities on which state and federal governments are demonstrably unwilling to spend general fund dollars. (Recall that a major source of LAWCON funding is offshore oil revenues and motorboat fuel taxes.)

On the whole, investors in intensively developed recreation such as marinas and ski areas have been modestly successful in receiving government support in terms of use rights on public lands, construction of roads, subsidized financing for buildings and pollution control facilities, and subsidized tourism promotion. But this seems to be changing. The opposition of environmental groups and nearby residents, financial difficulties, and the complexities of government permit processes are now the key factors affecting future developments of this kind.

One role played by government in recreation is the management of its own lands. Major opportunities for improved recreation supply exist on federal, state and locally owned lands. As an example, significant undeveloped opportunities exist on some 3 dozen Corps of Engineers reservoirs in New England (U.S. Congress, 1975). Much of the nonfederal land has the major asset of being close to the major cities.

Government affects recreational land supply profoundly through the tax system. Over the years, millions of acres of land have been preserved for public use by private charity. Prominent in fostering such donations have been the provisions of federal and state tax laws concerning charitable donations. Thus government, through its taxing power, has significantly promoted land supply for outdoor recreation.

Government sets the rules of liability for landowners and recreational users. One-sided views of this problem can fail to understand the issues in their full complexity. But clearly, on both public and private land, the allocation of liability appears as a significant role of government.

As an arbiter and definer of shifting public consensus on the content of property rights, government affects the right of the public to use privately owned land. Government is the only available instrument for expressing changing public attitudes about this problem. Unfortunately, it is likely that attitudes of small owners are changing away from allowing public uses of their land. Large owners still appear to accept a responsibility for public recreation access.

State and federal governments must play a major role in gathering and interpreting information, in developing and evaluating better management policies, and in basic research. A good part of the effort now invested in meaningless demand projections could profitably be diverted to studies of the costs and benefits of alternative policies for expanding the supply of recreation opportunity. The first step is a better data base on current effective land supply.

Public agencies have been crippled in the past by underfunded workloads in management, acquistion and enforcement. They have been unable to take active roles, except in a few cases, in promoting the application of private initiative to these problems. Numerous success stories exist. In our emerging era of financial stringency, we must look more and more to promoting our objectives by relying on the user groups themselves to organize and arrange for their needs.

The difficulty will be to employ private initiative in a manner that allows fair access to the general public. Already, significant opportunities for hunting are engrossed by individuals and private clubs leasing or owning land.[3] Often the members are more affluent than most. They have succeeded, however, in preserving their own recreation opportunities and in managing open spaces in a generally beneficial manner. But to remove the opportunity for exclusivity dilutes the incentive for private action.

---

[3] There is no good national data on the extent of privately leased land held by hunting clubs. In Alabama alone, some 2.5 million acres were leased by hunting clubs in the early 70's (Alabama SCORP, Vol. 20, p. 82).

Promoting the Private Sector

Far more effort should be devoted to increasing the role of profit-making enterprises in supplying outdoor recreation. In the 1977 NACD inventory, 44,356 out of a total of 71,483 enterprises were operated for profit. (National Ass'n of Conservation Districts, 1977). This base of successful enterprises should be used to expand in existing areas like camping, and could be an innovative source of supply for less traditional fields now handled by the public and nonprofit sectors. The Task Force Report (n.d.) prepared on this subject for the 1978 Nationwide Plan at least identified major issues, though it was flawed by self-serving argument and undocumented assertions. Serious research and case studies are needed to develop improved policies for promoting an expanded private role in providing recreation.

One key obstacle in promoting private recreation enterprise is the public provision of recreation at prices below cost. While this question is a complex and serious one, it appears to us that public recreation pricing policies should recognize thisconcern to a greater degree than is now the case. The enduring belief in "Davy Crockett Economics" -- hunting and fishing free of charge -- is a serious obstacle to progress.

In summary, the most important contributions that government can make to the supply of land for recreation are:

1. Develop more fully the latent opportunities on its own ownerships. Examples:
    (a) better access and land use at existing reservoirs;
    (b) effective access for winter recreation;
    (c) opportunities specifically for day use and short walks.
2. Use owned properties as cores for regional networks of water trails and land trails.
3. Promote self-help by organized private user groups and local governments. Perhaps the best example is the Appalachian Trial.
4. Effectively address the policy issues raised by public use of private land.
5. Promote development by the private sector.

Land Acquisition

The SCORPs and most traditional reviews have placed their primary emphasis on government acquisition of interests in land. Such interests have ranged from fee simple acquisition, to easements and other limited rights, to short-term leaseholds. While dramatic progress has been made in the past half century, much more needs to be done. Because of the steady pressure of development, which consumes three million acres per year, we can be confident that our current best efforts to acquire more land for public purposes will be appreciated by our descendants.

At the same time, fee simple acquisition for recreation encounters severe obstacles --

-- local opposition to removing land from tax rolls;

-- sentiment against government ownership and against single-purpose land uses;

-- the rapidly escalating cost of purchasing land.

These problems will cripple future land acquisition programs. To adapt, it will be necessary to pursue a mix of strategies. These will rely increasingly on less than fee methods tailored to specific purposes, such as fishing easements (in the 1960's, some 27 states had programs of acquiring fishing easements).

Programs of leasing private land should be de-emphasized in favor of methods offering more permanent protection. In SCORPs, several states report difficulty in maintaining leased acreage for hunting. The State of Pennsylvania operates one of the most extensive leasing programs, leasing 2.7 million acres from 16,000 cooperators. The State of Florida also has a large program.

Many states have traditionally planned land acquisition around providing access to water. This is a sound emphasis and should be continued, especially in view of the increased amenity value of waterways resulting from pollution cleanup. There is a serious danger that the recreation benefits of water pollution cleanup will simply be capitalized into private land values and not benefit the general public. For a useful review of one state's approach, see, the 1979 Connecticut SCORP (p. 143-163).

CONCLUSION

If sound recreational planning and development is to be carried out in the future, a comprehensive nationwide system for gathering information on the lands and waters available for recreation, classified by relevant variables, is essential. As we argue here, simply tabulating ownership and facility data tells us almost nothing about recreation land availability. The Heritage Conservation and Recreation Service (HCRS) should take lead responsibility for this activity, in close coordination with the U.S. Forest Service through its Resource Planning Act activities, and the Soil Conservation Service through the requirements of the Resource Conservation Act. HCRS should promulgate standards for assessment to ensure comparability and implement them through the existing State Comprehensive Outdoor Recreation Plan (SCORP) process.

This data base will be essential in evaluating existing programs and in suggesting cost-effective ways to increase effective access. It will allow a periodic appraisal of the true availability of land for recreation, a task which cannot be accomplished with existing data.

In research, case studies and pilot tests are needed to evaluate potential techniques for increasing the involvement of the private sector in providing and maintaining recreational lands and waters. Improved programs for increasing public access to private land, especially small holdings, are needed. Some of the effective examples of self-help by nonprofit user groups deserve analysis and emulation. Critical evaluation of existing programs, with particular emphasis on economic analysis of costs and benefits of their ability to provide needed recreational opportunities is needed. Only such a close look at various alternatives and their relative effectiveness in achieving expanded land supply will enable responsible agencies to keep up with the demands for increasing the land base available for outdoor recreation.

LITERATURE CITED

Alfano, Sam S. and Arthur W. Magill. 1976. Vandalism and outdoor recreation: symposium proceedings. U.S. Dept. Agric. For. Serv. Gen. Tech. Rept. PSW - 17. 72 pp.

Anonymous. (ed). 1975. Man, leisure and wildlands. Eisenhower consortium for western environmental forestry research. Ft. Collins. Bulletin No. 1 - 138 pp.

Birch, Thomas W. and Douglas S. Powell. The forest-land owners of Kentucky. USDA Forest Services. Resource Bulletin NE-57. 1978. 101 pp.

Birch, Thomas W. and Neal P. Kingsley. The forest-land owners of West Virginia. USDA Forest Services. Resource Bulletin NE-58. 1978. 76 pp.

Bryan, Hobson. 1979. Conflict in the great outdoors. University of Alabama, Bureau of Public Administration, Sociol. Stud. No. 4. 98 pp.

Connecticut Department of Environmental Protection. 1978. SCORP. Hartford. 434 pp.

Convery, Frank. 1979. Applications of economics in national forest planning. U.S. Dept. Agric. For. Serv. Southern Region. Atlanta, Ga. 182 pp.

Cordell, Harold K. and Stephen J. Maddock. 1969. Recreational policies of the major pulp and paper companies in the south. Jour. Forestry. 67(4):229-231

Hengsbach, Jeffrey L. A recreational study of the upper St. John River watershed. Maine Agric. Exp. Sta., Bulletin 682. 1970. 72 pp.

Kingsley, Neal P. The forest landowners of southern New England. USDA Forest Service. Resource Bulletin NE-41. 1976. 27 pp.

Kingsley, Neal P. and Thomas W. Birch. The forest land owners of New Hampshire and Vermont. USDA Forest Service. NE-51. 1977. 47 pp.

National Association of Conservation Districts. 1977. Inventory of private recreation facilities. Washington, D.C.. 155 pp.

Nordstrom, Paul E., Ted C. Stephenson and Lester Nies. 1977. Snowmobiling in South Dakota. South Dakota State University, Agr. Exp. Sta. Brookings. 283 pp.

Outdoor Recreation Resources Review Commission. 1962a. Hunting in the U.S. Special Report No. 6. Washington, GPO. 110 pp.

Outdoor Recreation Resources Review Commission. 1962b. Sport fishing today and tomorrow. Special Report No. 7. Washington, GPO. 99pp.

Patrick, David K. 1969. Role of industrial woodlands in recreation. Jour. Forestry 67 (9):625-627.

Payne, B.R., R.C. Gannon and L.C. Irland 1975. The second-home recreation market in the Northeast. U.S. Dept. of Interior, Bureau of Outdoor Recreation. Washington. 27 pp.

Quarterman, Russel T. 1975. Incentives to the use of land for outdoor recreation: insulation from tort liability, tax relief. Office of Special Projects, University of Georgia School of Law. 109 pp.

Sidaway, Roger. 1979. Long distance routes in England and Wales. In, W.R. Burch, Jr., ed, Long distance trails. New Haven: Yale School of Forestry and Environmental Studies. pp. 11-27.

Smith, Lincoln. 1950. The great pond ordinance -- collectivism in northern New England. Boston University Law Review, 30. pp. 178-190.

Stewart, Bruce E. 1963. Recreational use of private land in a portion of eastern Maine. Maine Agr. Exp. Sta. Misc. Pub. 658. Orono. 47 pp.

Strodtz, Gary L. and C.W. Dane. 1968. Trespassers, guests and recreationists on industrial forest land. Jour. Forestry, 66 (12) p. 898-901.

U.S. Congress, Senate. 1974. The recreation imperative. Committee on Interior and Insular Affairs. 93d Cong. 2d Sess. Washington. 389pp.

U.S. Congress, Senate. 1975. Studies of the water project recreation act. Committee on Interior and Insular Affairs, 94th Cong., 1st Sess. Washington. 70 pp.

U.S. Council of Environmental Quality. 1976. Subdividing rural America. Executive Summary. Washington GPO. 17 pp.

U.S. Department of Interior, Heritage Conservation and Recreation Service.

- Federal Outdoor Recreation Land - n.d. Task Force Report
- Nationwide Outdoor Recreation Plan. -Acquisition - LWCF. Washington. 17 pp.
- Nationwide Outdoor Recreation Plan. Review Draft var. pg. 1979.
- Needs of private for-profit enterprises in outdoor recreation. 51 pp.
- Role of Non-profit organizations in providing outdoor recreation opportunities. 19 pp.

TRENDS IN ORGANIZATIONAL MEMBERSHIPS AND LOBBYING

William R. Burch[1]

INTRODUCTION

People in the outdoor recreation business have long held certain inalienable and self-evident truths--recreation resources serve basic needs, the public needs to be professionally guided for "sound" recreational choice, nature is fundamentally good and all people can be trained to absorb that goodness and so on. Yet, of all these truisms, the most myopic is the faith that outdoor recreation is above politics.

Even the most casual observer of great American urban park systems can see much attention devoted to new facilities and very little to the dull business of maintaining old facilities and natural features. For the most part, Park Commissioners are political appointees and the most certain path for making a second ranked appointment powerful (Robert Moses is our guiding model here) is to build things. This has the advantage of awarding contracts to local businesses, of making local teamster and construction unions happy and ensuring something "concrete" to point to when constituents ask what you have done for them. The first principle of an effective outdoor recreation program is to build a constituency of powerful groups and/or to mobilize mass public opinion in support of recreation programs.

Trends in organizational memberships and lobbying efforts merely represent the barest tip of the underlying political realities. I will give most attention to these realities rather than the tip. We will consider the creation, allocation, diminishment, growth and exercise of social power as it influences outdoor recreation. For the most part we will be following theoretical clues rather than absolute, experimental proofs.

The reader who becomes queasy when the discussion turns to struggles between persons, groups and social classes for hegemony over others should be forewarned about out intentions. This paper is about that side of our political economy for which we go into the woods and recreate so we may pretend that such political realities do not exist.

Since our interest is in trends as they affect the management and planning of outdoor recreation facilities one must assume that we are interested in forecasting the future rather than merely reporting on the past. Yet, the humble art of forecasting has no hope unless we develop the rudiments of a theory. We will build our theory in as painless a manner as possible, though it will be based upon a social science tradition which assumes that the contours of the past and the future are the result of the struggle by groups to gain differential access to the scarce resources of earth and society. In short, one consistent characteristic of our species is the continuing struggle to get ahead and stay ahead.

Consequently, we will ignore our species altruistic characteristics and the inherent goodness of outdoor recreation to concentrate upon the inherent conflicts of outdoor recreation. We will suggest that the transition from a work-directed to a consumption-directed political economy is creating new class alighments, of which the outdoor recreation area is a prime indicator of essential conflicts. Next, we will consider some general explanations of power distribution in the American political economy and suggest how it relates to our understanding of outdoor recreation politics. Next we will consider some population characteristics that will affect the influence of outdoor recreation. This will be followed by an examination of participation trends and expenditures. We will conclude with a look at the future.

THE POLITICAL STRUGGLE OF OUTDOOR RECREATION

The American outdoor recreation resource is the product of continuing and often violent political struggles. It is a struggle as much for the hearts and minds of the masses as it is a struggle for landscapes. This is because outdoor recreation represents a fundamental turnaround from favored myths of early capitalist political economies which assumed that the lot of man was an unending, bleak and eternal scarcity which could only be partially held in check by an equally bleak, eternal and unending work. In contrast, the myth of the modern consumer society promises unending, ever mounting consumption which demands only the minimal amount of work. Let us be clear. This is a fundamental shift, whose origins are as recent as the 1950's and as old as the fabled South Pacific Islands. The conclusions of this change are just now being worked out in terms of greater laxity regarding sexual identities, gambling, pornography, drugs and significant increases in "adult" leisure villages, golden age clubs, environmental quality laws, open space preservation and emerging professions of recreation management, tourism and so forth.

---

[1] William R. Burch, Yale University. I am most grateful to Richard Mordi for his struggle to track down "unavailable" data and Joe Miller for his always sound guidance and advise.

In short, the decade of the 80's should complete the transition from a world dominated by a homogenous small town, rural work ethic to one dominated by a diverse, urbanized, and sensate ethic. Reflect upon the early forest reserve acts in the late 1800's which were to remove from the vagaries of the market, resources such as forests and watersheds. Then early in the century there was the demand to extract utility from these reserves. Pinchot wanted to have professional foresters make the forests more efficient. Steve Mather wanted to have the National Parks serve a higher moral purpose in educating the masses. The moral tone of our wildlands was given its strongest boost in the 1930's CCC activities which were to do good for both resources and unemployed youths. Yet, by the 1950's and the Mission 66 era, a new fun morality began to enter the wildlands. New devices like water skis, downhill skiing, trail bikes and later snowmobiles and off-road vehicles (ORV) emphasized the search for disequilibrium and its mechanical ease in attainment. While camping was converted from roughing it to all the mobile comforts of home.

Outdoor recreation has been at the center of conservation conflicts because many of the issues have stemmed from two opposed perceptions--(1) the esthetic and moral appreciation of wildland experiences such as Theodore Roosevelt and Justice William O. Douglas and (2) materialist interest in exploitation such as the campaign by Walter Hickel and other "concerned" Alaskans to not "lock up" their resources. This political struggle has had at least five cycles. The first phase was where old wealth esthetes such as Gifford Pinchot and Theodore Roosevelt confronted the new corporate and regional monied persons regarding commodity exploitation. The result was the removal of many significant resource decisions from the realm of the market to the realm of professional decision. The second phase was the consolidation of resource rationalization in the 1930's which also saw leisure (free play) become recreation (organized play) under the guidance of professionals who now organized and rationalized what we once did on our own. In the 1950's, the third phase emphasized the "fun" of wildlands. Technological and financial innovation encouraged a shift from self denial and complicated skills to comfort and ease of performance. This period's rapid growth in the technological means of fun provides for a significant break between the masses and the rising new intelligencia. The masses continue to emphasize fun, comfort and diversion while the legislative acts pushed by the intelligencia stress a return to the stern morality of nature.

The message of the fourth phase in the late 1960's and early 70's was that resources are scarce, and work, pain and sacrifice are the natural condition of mankind. Therefore, we must regulate our behavior to match such a "reality." This most recent cycle represents a new struggle. Where prior struggles were between commodity exploiters and the esthetes and recreationists, the new struggle is between the recreationists and the esthetes. One cannot stress too heavily that the legislative gains of the environmental decade (1964-1974) were largely restrictive whether the establishment of wilderness areas and the rationing of their use or air and water quality standards or the National Environmental Policy Act. We should recognize that the amount of public land removed from commodity and mechanical recreation use has grown from around 9 million acres in 1964 to over 15 million acres in 1979. Figure 1 illustrates the growth of environmental regulations.

The 1980's are opening the fifth phase where these cavalier struggles will become more intense as the attainment of the standard American dream becomes more and more difficult. In an earlier period when lines were being drawn on relatively blank maps, there were advantages for large corporations to encourage "locking up" and therefore minimizing competition from "cheap" government resources, while recreationists and esthetes had enough room to ignore their fundamental incompatibilities. Today the issues are not "out there" but right in the backyard, and general principles tend to get ignored once the specifics are self evident. "Stopping the loggers" can be very satisfying until one realizes that wilderness designation means that one can no longer chase about on a snowmobile or ORV. Protecting the California desert is absolutely essential until one realizes that a recreation emphasis soon leads to preservation actions such that ORV access declines from nearly 100 percent to less than ten percent of the area.

Contributing to the tension between different visions of nature--utility and esthetics--are the large corporations that have grown up to serve the leisure markets. The high technology backpacking, biking, canoeing and other esthetic sports combine with "high quality" leisure villages and "ecologically" sound ski resorts to serve well educated professionals and their families. While major manufacturing

Table 1.--Comparison of enforcement actions and categories

------------Water Enforcement---------------	Dec. 1970-Nov. 1972	Dec. 1972-Nov. 1974	Dec. 1974-Nov. 1975
------------Water Enforcement---------------			
Federal Water Pollution Control Act[a]			
Civil suits referred by EPA(10 [g] or 309)	4	22	123[b]
All 311 oil spill referrals	30	995	2,260
180-day notices	175	-	-
Conferences	33	-	-
Abatement commitment letters	300	-	-
Criminal actions(Sect. 309)	-	15	-[b]
Administrative orders(Sect. 309)	-	455	829
NPDES referrals to states(Sect. 309)	-	6	-
Minor spills(Sect. 308)	-	7	-
NPDES information orders(Sect. 308)	-	5	-
Total FWPCA	542	1,505	-
Refuse Act			
Civil(EPA initiated)	89	15	-
Criminal(EPA initiated)	157	85	-
Non-filters	86	-	-
Civil(DOJ initiated with EPA assist)	49	-	-
Criminal(DOJ initiated with EPA assist)	54	-	-
Total Refuse Act	435	100	-
Ocean Dumping Act	-	8	7[d]
Total Water Enforcement	977	1,613	3,320[e]
-------------Air Enforcement----------------			
All types for both stationary and mobile sources	28	440	1,477[f]
----------Pesticides Enforcement------------			
Criminal cases	159	235	8
Civil cases	-	569	355
Recalls-formal only	-	64	81
Stop sale,use,removal,and seizures	23[b]	160	214
Citations	-	576	-
Warning notices	-	1,206	1,001
Import detentions	-	198	189
Civil penalty warnings	-	7	57
Total Pesticides Enforcement	182	3,015	1,905
------------Total All Actions---------------	1,187	5,068	6,702

[a] The FWPCA was amended in October 1972.

[b] Seizures only.

[c] Civil and criminal actions combined.

[d] Includes Refuse Act enforcement.

[e] Includes 101 notices of violation under Sect. 309.

[f] Includes 774 mobile sources.

and tourist centers combine to produce trail bikes, ORV's, snowmobiles and other mechanized diversions for their well-paid, highly skilled blue collar and business clientele. Consequently, some interesting rhetorical alliances are emerging. Boise-Cascade expresses its indignation at "elites" who would "lock up" wildlands from the enjoyment of ordinary ORV campers. While conservative members of the old wealth must hold their noses and join with some unwashed remnants of the now old, new left, as they seek to ban motorized access to nature and the backyards of their country estates.

Figure 1. New state laws and regulations, through July 1976

Up to and including	general	air	water	solid waste	land use	radiation	pesticides	noise	hazardous substances
	new laws								
1969	2	5	3	12	1	13	13	0	0
1970	2	3	3	3	0	1	4	0	1
1971	5	6	13	13	4	4	9	1	2
1972	8	9	11	11	6	2	9	4	2
1973	7	4	15	10	4	1	9	2	1
1974	16	9	11	16	9	0	4	2	0
1975	17	16	15	13	25	2	17	1	1
July 1976	5	1	5	5	7	3	6	1	0
	new regulations								
1969	0	17	12	6	1	14	8	0	0
1970	1	4	4	3	2	3	3	0	0
1971	1	27	14	18	2	5	8	1	1
1972	2	68	22	18	6	13	9	3	0
1973	8	32	41	15	4	11	7	1	0
1974	1	49	51	20	10	4	9	2	5
1975	5	96	83	26	12	3	12	2	1
July 1976	0	45	13	5	1	5	3	0	2

SOME THEORETICAL ISSUES

Power in America is exerted in a variety of forms--a few very wealthy families, some powerful economic units such as the Fortune 500 corporations and large labor unions such as the Teamsters, large government bureaucracies such as HEW and so forth. Yet, these more visible elements of our political life create and are dependent upon a great variety of voluntary associations. Arnold Rose (1954) suggests that such associations are important elements of democratic systems. He identifies three major functions of such associations--(1) they distribute power over a wide range of social life; (2) they provide a sense of satisfaction with democratic processes; and (3) they are social mechanisms for continually instituting social change.

The following table indicates the large number and range of voluntary associations. Trade, business and commercial organizations furnish, by far, the largest number of such organizations and though the number has grown, they have a smaller proportion relative to other organizations. Cultural, health, educational, scientific and religious organizations had relatively high proportions of the total number of organizations in 1973.

Yet, when we look at membership rather than the sheer number of organizations the hierarchy of organizations changes. Church affiliated groups are by far the largest, with sports groups, labor unions and school groups such as PTAs being the next most popular. Of course, membership numbers do not measure effectiveness of action by an organization. In general, the most effective organizations are those most closely related to our culture's central acquisitive goals. Industrial and trade associations seek favorable protection and minimal regulation from the government. Labor unions seek protection and improvements in the wages and working conditions of their members. Professional associations seek to protect and increase their monopolization of particular esoteric skills. Minority and ethnic groups seek reform and enhancement of opportunities for their members. In one sense all of these groups are struggling over a larger share of reasonably finite resources of wealth. Consequently, their interest in outdoor recreation locales and environmental matters is merely a continuation of their basic struggles, though with a different setting.

Still, in spite of a large number of voluntary associations, some legislative and administrative victories, and considerable media attention, the basic issues raised by outdoor enthusiasts and environmentalists have low priority. Matters of war, energy, crime, economic growth, airports, highways, public health, housing investments and, occasionally, racial or student troubles continue to assume greater importance at those nodes where key social decisions are made.

Delbert Miller's (1970) study of the visible decision-makers in Megalopolis found that their interest in environmental problems was low. He reports that "6 percent of their

Table 2.--Selected national organizations, by type
(Covers nonprofit organizations of national scope)

Type	Number 1968	Number 1970	Number 1973	Percent Distribution 1968	Percent Distribution 1970	Percent Distribution 1973
Total	[a]10,299	[a]10,734	12,628	100.0	100.0	100.0
Trade, business, commercial	2,832	2,895	2,922	27.5	27.0	23.1
Agriculture	491	508	609	4.8	4.7	4.8
Governmental, public administration, military, legal	301	346	407	2.9	3.2	3.2
Scientific, engineering, technical	488	548	818	4.7	5.1	6.5
Educational	[b]1,286	[b]1,383	869	12.5	12.9	6.9
Cultural	(b)	(b)	1,197	(b)	(b)	9.5
Social welfare	389	475	753	3.8	4.4	6.0
Health, medical	791	830	1,090	7.7	7.7	8.6
Public affairs	446	498	792	4.3	4.6	6.3
Fraternal, foreign interest, nationality, ethnic	640	610	485	6.2	5.7	3.8
Religious	794	806	729	7.7	7.5	5.8
Veterans, hereditary, patriotic	197	198	219	1.9	1.8	1.7
Hobby, avocational	423	444	608	4.1	4.1	4.8
Athletic, sports	318	336	448	3.1	3.1	3.5
Labor unions	237	226	240	2.3	2.1	1.9
Chambers of Commerce[c]	126	110	109	1.2	1.0	.9
Greek letter societies	351	334	333	3.4	3.1	2.6
Other, not specified	189	187	---	1.8	1.7	---

[a] Includes associations not shown separately.

[b] Cultural included with educational.

[c] National, binational, and international.

Table 3.--Membership in various groups and organizations

Type of group or organization	1974			1975		
	Total responding (thous.)	Number of members	Percent of total	Total responding (thous.)	Number of members	Percent of total
Fraternal groups	1,462	203	14	1,463	160	11
Service clubs	1,461	132	9	1,463	124	8
Veterans' groups	1,464	132	9	1,464	114	8
Political clubs	1,464	66	5	1,460	64	4
Labor unions	1,465	241	16	1,459	230	16
Sports groups	1,464	262	18	1,464	278	19
Youth groups	1,464	153	10	1,462	144	10
School service groups	1,462	259	18	1,461	206	14
Hobby or garden clubs	1,462	143	10	1,456	129	9
School fraternities or sororities	1,462	69	5	1,459	64	4
Nationality groups	1,462	52	4	1,454	37	3
Farm organizations	1,462	63	4	1,459	61	4
Literary,art,discussion or study groups	1,461	137	9	1,457	133	9
Professional or academic societies	1,462	193	13	1,461	174	12
Church-affiliated groups	1,475	621	42	1,465	588	40
Any other groups	1,451	151	10	1,450	126	9

interests are in air pollution, 3 percent in water pollution, 2 percent in solid wastes, and 4 percent in planning, zoning and preservation of open land--a total of 15 percent." Selznick (1966), Hardin (1967), Foss (1960a, 1960b), Cooley (1963) and others have demonstrated how, in the U.S., laws and agencies designed to protect and conserve ecosystems tend to become coopted by the relevant circles of power. The unintended consequence is that conservation law often tends to accelerate environmental deterioration while conservationists have not found their way into the interorganizational "web which depicts the structure of enduring community power." (Perrucci and Pilisuk, 1970:1044). This failure may reflect the peculiarities of power organization within the conservation community itself.

For example, parks, forests, wilderness areas, campgrounds, lakes, seashores and other physical locales are basic elements of the tourist industry. Yet, professional managers of these locales seldom recognize or accept that they are primarily in the people (tourist) serving business. Indeed, the real nature of the services these professionals provide is not unlike that provided by the Disney-type theme park professionals.

Part of the reason for seeing the connection between outdoor recreation services and other tourist services is that most professionals come from biologically oriented disciplines and are unwilling to leave the trees and see how they can encourage rather than restrict use of their facilities. Consequently, these keepers of our sacred groves often fail to note the connection between their careers and government responses to energy shortages. In the 1973 oil embargo crisis, the government declared that tourism was a "non-essential" industry. The Carter administration has sought to eliminate the U.S. Travel Service (which encourages many foreign tourists and their hard currency to visit our parks and wildlands), has major plans to curtail the recreational use of automobiles, pleasure boats and recreational vehicles.

One looks in vain for the park and forest managers who have protested this blow to their recreational clientele. Yet, even the casual observer can note that on weekends most autos have two or more people in them, while on weekdays they seldom contain more than one person in the bumper-to-bumper parade. Indeed, the highest, best, most conservative and efficient use of automobiles is likely to be as a devise of outdoor recreation. And though the outdoor recreation professionals have not participated, the tourist industry has struggled to protect leisure-time travel. They are just now entering politics to demonstrate the importance and social value of their industry. As they note (ASTA, 1980:39):

> It has been said that the force of real events ultimately pushed an industry toward the right decisions, whatever the countervailing arguments for inaction may be. The events witnessed by the tourism industry in the past few years should have demonstrated that the time is more than ripe for a decision to put in place a strong travel industry educational program dedicated to the enlightenment of government officials and the general public, stressing the important beneficial role of tourism in our nation's economic and social structure. It is time to replace alarmed innocence with sophisticated realism. The tourism industry as a matter of self-preservation must develop a strong political constituency. (Underlining in original quote.)

It appears that the tourism industry is going to try and join the oil, chemical, auto, clothing, shoe and other industries in demonstrating the linkage between it's health and the survival of the nation. For the most part, outdoor recreation and nature conservation are intimately connected to the success of the tourism campaign. Therefore it may be of value to explore some ideas on the nature of our nation's political structure.

There have been two major theoretical perspectives in the study of social power--elitist and pluralist. Each has a distinctive methodology, tradition and ideological tinge. Elitists such as G. William Donhoff (1967), C.M. Mills (1956), Floyd Hunter (1959) and T.B. Bottomore (1964) have tended to use some version of the reputational method to discover the power behind the visible decision makers. Pluralists such as Arnold Rose (1967) or Robert Dahl (1958, 1961) tend to focus upon the relevant leaders concerned with a specific issue and find a diffuse shifting power structure which varies from issue to issue. Miller's (1970) study of decision making and power in megalopolis regarding environmental quality problems is more in this latter tradition.

John Walton (1966) has argued that there are not one or even two types of power structures but four--pyramidal, factional, coalitional, and amorphous. Perrucci and Pilisuk (1970) suggest that a better means for examining the power structure is through examining the interorganizational basis of power. They argue, "...no one person commands all the resources sufficient for influencing or intimidating others to see things his way. Persons who influence decision-making, and are thus called powerful (whether in one issue or across many issues), must therefore draw upon the resources of others as well as their own in order to exercise their power." (Perrucci and

Pilisuk, 1970:1042). They then formulate a theoretical statement about, "...a locus of enduring power to which both elitists and pluralists may subscribe; i.e., the resources relevant to the existence of power are dispersed and reside in the interorganizational connections that may be mobilized in specific situations, particularly dealing with allocation of scarce values." (Perrucci and Pilisuk 1970:1042-3). In their study of a small midwestern city, they find a power elite which is not interested or involved in every community decision. Yet, in major policy conflicts only this elite is able to mobilize the actual power, common interests, and social ties which assure an "outcome favorable to its interests."

Their discussion, as Walton's (1966) identification of four types of power structures, suggest that power in indurstial societies is less a matter of individual characteristics than of group and community characteristics. Business, labor unions and government bureaucracies are more likely to assume and use a pyramidal form of power. They reflect an interest in mobilizing control over the scarce resources of social wealth. The factional pattern would be most characteristic of elected officials who are primarily interested in controlling the scarce resources of social power. While the amorphous pattern would be most characteristic of representatives from the world of art, intellect or the media of information where the primary contention is over the distribution of social deference. Coalitional patterns would emerge when one or more of these sectors are involved in a particular issue. I am, of course, aware of the degree of interdependence in these sectors, businessmen and politicians need one another as both need some validation or recognition from the realm of deference. It would seem that outdoor recreation and environmental affairs will most closely follow coalitional patterns.

Still, there is a need for some framework which permits us to note how coalitional patterns might develop and to identify the set of conditions under which certain patterns of power are relevant. The idea of social circles as suggested by Simmel (1955) and expanded by Kadushin (1966, 1968) and others seems a likely means for such examination. Kadushin (no date: 5-6) characterizes the social circle as a prototype of informal interaction systems which has three defining characteristics:

"1. Members of a circle are linked to each other not necessarily through face to face interaction, but may be linked through third parties.

2. The network exists because it fulfills some need of its members--because they share some common interest which may be political or cultural.

3. The circle is not formal. That is, there are a) no clear leaders although there may be central figures: b) there are no clearly defined goals, though circles almost always have an implicit function...c) there are no definite rules which determine modes of interaction, though there are often customary relationships; and d) there are no distinct criteria of membership."

Kadushin (no date:6) then goes on to indicate how the social circle theory can be applied in the study of power and influence. In this study there are three formal questions involved:

> "1. The degree to which elites form one or more circles;
>
> 2. The degree to which the circles have tight or loose internal connections;
>
> 3. The degree to which the various circles (if there are more than one) in various sectors such as science, business and politics, are linked together into a 'super-circle'."

Until recently (at least in the U.S.), the basic strategy of the conservation movement has existed within the frame of social circles. The interests of the movement have been devoted to issues of open space and natural esthetics. Such interests are somewhat akin to support of the arts, good government and other activities which serve to validate that the children of "new wealth" have "earned" deference for their taste and sensitivity. The issues of arts, aesthetics and parklands have seldom touched the deepest concerns of an expanding, semi-capitalist society. In the early stages of the movement, offending industrial groups were seldom power companies, railways, auto manufacturers and so forth, but tended to be relatively decentralized industries such as the lumber industry. Further, the socialization of land took place in sparsely settled and relatively impoverished colonial states--Oregon, Montana, Kenya and so forth. Consequently, it has been fairly easy to establish a National Park in the State of Washington but nearly impossible in the State of New York or Connecticut, though equally desirable tracts of open space are available in the latter two states. Thus the main thrust of the traditional, old-line conservation community has been the protection of sacred wildland spaces and wild animals.

Such issues are no longer central in the new ecological concern but touch the most sensitive and tradition-bound areas--procreation, capitalist organization, democratic federalism, economic growth and so forth. And these newer concerns confront a quite different system of organized power. Thus in the past, persons could chair large corporations whose pollution flowed unchecked, while they devoted their civic talents to Lincoln Centers, Metropolital museums, national parks, zoological gardens and the Audubon Society. As noted earlier, it is difficult to imagine how these easy separations can continue when the crucial decisions are no longer "out there."

In the past, outdoor recreation and environmental protection could be seen as something "nice" to do by public benefactors and relatively weak government agencies. They were given hunks of unwanted land and minimal budgets to manage them. Today the growth in acquisition is nearing completion with only the difficult, unending, increasingly expensive and politically unrewarding maintenance demands stretching into the future. As Table 4 indicates, the oldest park systems--in our cities--are spending the bulk of their money on maintenance, while the younger federal and state programs are likely to enter a similar expenditure pattern in the late 1980's. Consequently, outdoor recreation is no longer simply frosting but is an important part of the cake (see the table on per-capita state expenditures).

Table 4.--Federal government expenditures for outdoor recreation

	1971	1972	Est. 1973
Capital Expenditures, Total	$228	$290	$289
Land Acquisition	134	161	117
Development & Other	94	129	172
Operation & Maintenance Expenditures, Total	220	273	284
Salaries & Wages	156	175	179
Other	64	98	105
Total Expenditures[a]	448	563	573

[a] Table based on reports received from individual agencies administering recreation lands within each governmental jurisdiction. Data include only dollars primarily used for public outdoor recreation purposes. Federal data was reported by the National Park Service, Bureau of Land Management, Bureau of Sport Fisheries and Wildlife, Bureau of Reclamation, Forest Service, Corps of Engineers, and Tennessee Valley Authority. Federal land acquisition expenditures also include those of the Bureau of Outdoor Recreation for the Redwood National Park.

In an era of shrinking tax dollars and fixed levels of public land, close attention will be given to the trade-offs between nongame and game species, wilderness and ORVs, air quality standards and fuel economy. Outdoor recreation enters the politics that Robert Lekachman (1973:78) calls:

> "a covert hunt for new privilege and government-created property, an avid search for franchises, airline routes, television channels, acreage allotments, tax advantages, ingenious subsidies, and grazing privileges at concessionary rates. The pricing decisions of the major corporations which exercise substantial power over their market amount to still less supervised creations of new property in the shape of excess profit."

Table 5.--State government expenditures for outdoor recreation (in millions of dollars)

	1971	1972	Est. 1973
Capital Expenditures, Total	$271	$338	$352
Land Acquisition	81	138	134
Development & Other	190	200	218
Operation & Maintenance Expenditures, Total	257	276	309
Salaries & Wages	172	191	212
Other	85	85	97
Total Expenditures[a]	528	614	661

[a] Table based on reports received from individuals, agencies administering recreation lands within each governmental jurisdiction. Data includes only dollars primarily used for public outdoor recreation purposes. The inventory includes all State agencies. Data adjusted for nonreported values.

Table 6.--Local government expenditures for outdoor recreation (in millions of dollars)

	1971	1972	Est. 1973
Capital Expenditures,total	752	883	1,216
Land Acquisition	299	312	430
Development & Other	453	571	786
Operation & Maintenance Expenditures, total	1,000	1,108	1,239
Salaries & Wages	707	781	870
Other	293	327	369
Total Expenditures[a]	1,752	1,991	2,455

[a] Table based on reports received from individual agencies administering recreation lands within each governmental jurisdiction. Data include only dollars primarily used for public outdoor recreation purposes. The inventory included all counties, cities with over 5,000 population, townships with greater than 25,000 population, park and recreation districts and regional councils. Cities with less than 5,000 population and townships with less than 25,000 were sampled and expanded to reflect the total universe. Both sampled and nonsampled data were adjusted for nonreported values.

Table 7.--Per capita expenditure on local parks and recreation, by state. Per capita amounts of selected items of state and local government finances: (Direct general expenditure)

1965-66		1975-76	
U.S. Average	6.05	U.S. Average	18.00
Median State	4.35	Median State	14.07
District of Columbia	19.37	Nevada	45.46
Hawaii	16.56	Hawaii	36.62
Nevada	15.44	District of Columbia	33.02
California	10.89	Maryland	32.60
North Dakota	10.19	Colorado	30.42
New York	9.17	California	29.40
Wisconsin	8.92	Minnesota	28.88
Florida	8.49	Washington	27.15
Illinois	8.41	Arizona	24.20
Minnesota	8.22	Florida	22.75
Maryland	7.46	New York	21.81
Washington	7.46	Illinois	21.58
Colorado	6.44	Wisconsin	20.14
New Jersey	6.26	Oregon	19.63
Michigan	5.94	New Jersey	19.58
Arizona	5.89	Michigan	18.87
Utah	5.76	Missouri	18.01
Connecticut	5.71	Utah	17.21
Missouri	5.65	Alaska	17.02
Oregon	5.37	Connecticut	16.85
South Dakota	5.32	Iowa	15.72
Georgia	5.08	Nebraska	14.90
Louisiana	4.80	Tennessee	14.45
Massachusetts	4.65	Alabama	14.27
Oklahoma	4.56	Oklahoma	14.15
Nebraska	4.35	Virginia	14.08
Texas	4.31	Louisiana	14.03
Pennsylvania	4.26	North Dakota	13.93
Iowa	4.23	Massachusetts	13.65
Ohio	4.23	Texas	13.41
Rhode Island	4.14	Pennsylvania	13.19
Indiana	3.50	New Mexico	13.06
Tennessee	3.43	Ohio	12.57
New Hampshire	3.36	Wyoming	11.40
Virginia	3.28	Montana	11.11
Kansas	3.26	Delaware	10.63
Alaska	3.23	South Dakota	10.60
Delaware	3.09	Kansas	10.42
Idaho	2.90	Georgia	9.71
Montana	2.86	North Carolina	9.71
Wyoming	2.71	Rhode Island	9.66
Alabama	2.60	Indiana	9.37
West Virginia	2.35	Idaho	9.06
New Mexico	2.15	Maine	8.46
Maine	1.89	West Virginia	7.34
North Carolina	1.80	New Hampshire	7.18
South Carolina	1.72	Vermont	6.68
Kentucky	1.54	South Carolina	6.63
Arkansas	1.45	Kentucky	5.92
Vermont	1.33	Arkansas	5.34
Mississippi	1.08	Mississippi	5.16

SPECULATING ON SOME TRENDS

The environmental and outdoor recreation organizations had their biggest membership booms in the 1965-1971 period. After that, as Denton Morrison (1980:8) observes, there was:

> "...a slowed membership growth, steady-state, and in some instances, the reversal of the previous growth trends. There was much shaking out of the voluntary groups. Particularly groups organized independently at local and state levels and those that had most of their support base in the youngest part of the population (e.g., students) tended to falter in viability, to decline, and in some cases to disappear. The larger, older, nationally based groups and a very few of the newer national groups (e.g., Friends of the Earth, Environmental Action) managed to consolidate gains and substantially to maintain memberships, even though their rapid growth of membership around Earth Day leveled visibly. A few such groups (e.g., Zero Population Growth) experienced dramatic drops in chapters and in membership and then, apparently, achieved a somewhat fragile stability at a much more modest level."

An example of these changes can be seen in comparing the patterns of growth represented by the Wilderness Society and the Audubon Society. The Wilderness Society is a single issue, purist ideological group without major land holdings. The Audubon Society is a multi-issue organization with a middle of the road or "balanced" ideology group with substantial land holdings. The Wilderness Society is experiencing a stabilization and decline in membership growth at around 60,000 while the Audubon Society continues to expand its position in the middle of the outdoor recreation-environmental protection spectrum far beyond the 400,000 mark.

Our analysis of trends in subscriptions to journals of various outdoor recreation interests indicates there is a fairly rapid peaking of subscriptions within a relatively short time period. Then there is considerable stabilization with some mainline journals continuing while a number tend to die off after the initial flush of the activity. Motorcycle and recreational vehicle journals seemed to have especially high proliferation rates and equally high mortality rates. One suspects these journals follow the natural law of industrial concentration. This is where an innovation is introduced, such as the automobile or snowmobile, whose relatively open and large market encourages a large number of manufacturers; then the initial period of proliferation is followed by high rates of firm mortality, judicious coalitions and saturation of the market until only one or two major manufacturers remain.

There seems an equal trend in which at first a few enthusiasts actively participate in a new sport. At this stage, there is a good deal of esoteric love and high accident rates. Then there is the formation of organizations to ensure access to necessary resources and to police the behavior and image of participants. This then evolves to the stage where organized and later televised competition emerges with the active involvement, guidance and funding of manufacturers. Consequently hot rodders, dirt bikers and snowmobilers gradually find themselves in the position of spectators and persons who are expected to model themselves on the performance of manufactured heroes and heroines. These patterns are not as frequently found in the less mechanized outdoor activities. Partly this is because many of these activities do not as easily lend themselves to spectacle. However, mountain climbing, cross country skiing, sailing and river running suggest a similar pattern.

The mingling of those who have an economic stake in the perpetuation, increase and security of a locale for an outdoor activity with those who are hard core activitists (and consumers) is an association not often found in other commercial transactions of our society. However, the use of technology to make an activity easier and therefore expand its use more widely among the population seems to be a characteristic of all industrial activities. The conversion of participatory activities into spectator activities to increase consumption is well known among those with a financial stake in commercial sport. Yet, in all cases the prosletizing for a particular activity soon reaches a point of saturation and stability. There are only so many consumers for high technology backpacks, exotic sports cars, fast dirt bikes and fans of hockey or indoor soccer. Consequently, outdoor organizations and activities tend to assume a pyramidal structure as discussed by Walton. Some organizations emerge as the dominant ones in a particular activity and some activities assume dominance over others.

Bevins and Wilcox's (1979) comparison of camping trends and sales trends in tents and RV shipments emphasizes the new domination of the RV. Their trend data (Figure 2) further illustrate the "hierarchy" of certain outdoor activities over others (see Figure 3 and Table 8). It is essential to note the basic stability in the ranking of preferred activities and the generally low appeal of most outdoor activities to most Americans.

Table 8.--Recreation days per participant for activities included in three nationwide recreation surveys: 1960, 1965, and 1972.

Activity	1960-61 ORRRC Days/participant	Rank	1965 BOR Days/participant	Rank	1972 BOR Days/participant	Rank
	-summer unless noted--		------full year-------		--------summer--------	
Bicycling	19.4	1	20.6	1	12.9	1
Playing outdoor sports or games	12.3	3	17.3	2	9.8	2
Walking for pleasure	13.1 (Winter)	2	15.2	4	9.1	3
Swimming	11.5	4	14.3	5	9.1	3
Bird watching			15.9	3	6.7	9
Driving for pleasure	12.7	5	12.1	6	7.5	7
Fishing	6.8	7	7.6	7	7.3	8
Camping	5.7	8	6.9	8	8.9	5
Horseback riding	7.5	6	6.8	9	6.1	11
Sightseeing	5.2	12	6.6	10	6.1	11
Water skiing	5.1	14	6.6	10	6.5	10
Other boating	5.5	10	6.5	12	5.5	14
Nature walks	5.2 (Fall)	12	5.9	14	5.6	13
Sailing	3.0	17	6.2	13	8.4	6
Attending outdoor sports events	5.5 (Fall)	10	5.8	15	5.1	17
Hunting	5.6 (Fall)	9			4.3	18
Hiking	4.4	15	5.1	17	5.3	16
Picnicking	4.0	16	5.6	16	5.5	14
Canoeing	3.0	17	4.5	18	4.1	19
Attending outdoor concerts, plays, etc.	2.4	19	3.0	19	2.6	20

Note: Rank comparison is more meaningful than actual days because length of seasons used differ among surveys.

Figure 2.--Camping participation related to tent sales and recreation vehicle shipments (Bevins and Wilcox, 1979).

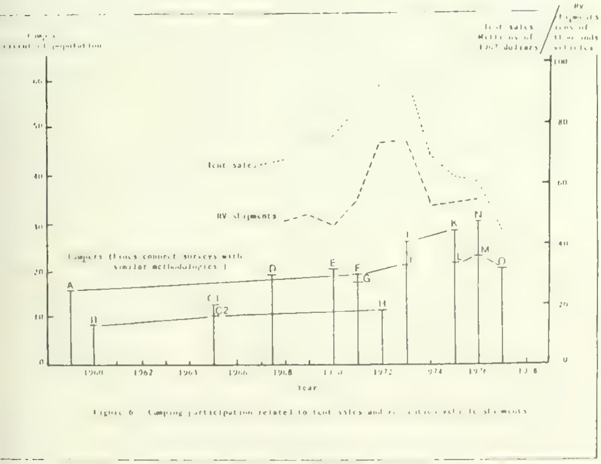
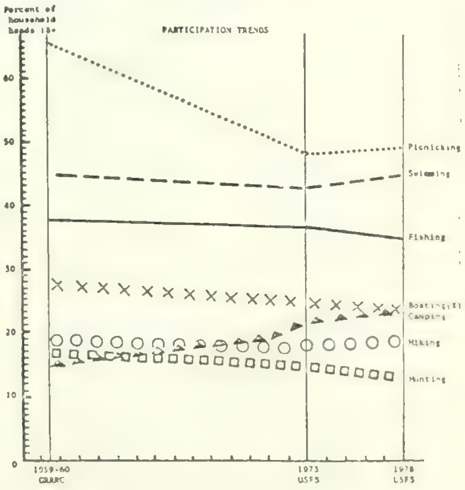


Figure 3.--Participation rates of household heads in seven popular activities, 1959-60; 1973; and 1978. (Bevins and Wilcox, 1979).



The stable ranking of activities suggests something of the potential for trends in outdoor recreation organization memberships and lobbying. An organization that can combine several activity interests and link these to economic forces is more likely to grow than a single interest, non-economic organization. And of the overall potential for outdoor recreation membership growth is stabilizing and/or being challenged by other interests then lobbying will be increased. Our remaining time will be spent looking at those social forces influencing membership and lobbying trends.

THE FUTURE

It would seem that two forces which would affect potential growth of outdoor organizations are population growth and disposable income. Figure 4 illustrates that population growth is consistently declining. If present patterns of reproductive behavior continue it would seem that there will be fewer and fewer persons available as potential members for outdoor activities and organizations. This seems especially so when we consider Figure 5 on personal consumption expenditure since 1946. The high economic growth of the post second world war period has permitted a gradual rise in recreation expenditures. However, the post OPEC period suggests that higher and higher proportions of disposable income will go for food, housing and transportation with recreation, education and personal business showing sharp declines. So the combination of declining population and disposable income would suggest a marked slowdown in interest and financial ability to participate.

Figure 4.--Rate of change in population and labor [illegible] by sex [illegible].

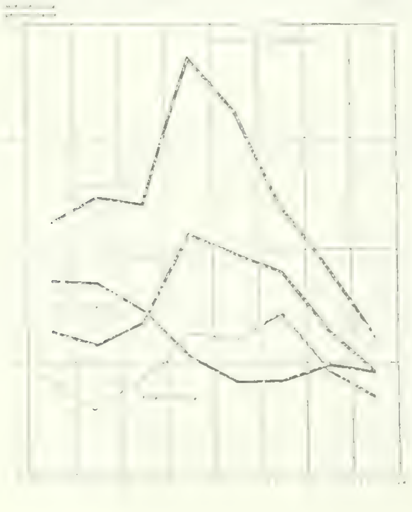
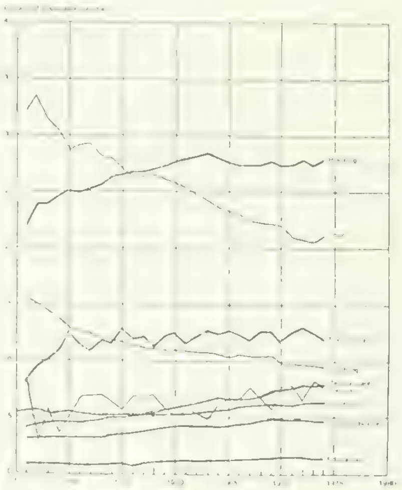


Figure 5.--Personal consumption expenditures, by type of product and service: 1946 - 1974



This projection undoubtably represents certain basic trends. However, people do not live by bread alone. Indeed, a substantial economic depression increases non-work time and increases the demand upon open spaces and parks. Further, participation in voluntary organizations is not randomly distributed over the population. As John Robinson's study of time budgets illustrates, the most active volunteers tend to be better educated, younger and female. As Table 9 indicates, the trend from 1965-1975 is for increased time to be spent upon volunteer time.

This is particularly interesting when we consider Robert Mitchell's (1979) post Proposition 13 national survey that found strong continuing support by all classes and social groups for environmental protection. Yet, of most interest are the factors associated with membership in environmental organizations. Even though only eight percent of the population were members, white male, post graduates earning over $30,000 per year, with independent party affiliation and liberal ideology were characteristics overrepresented among the joiners. In short, the new professional classes are significant factors in carrying the environmental quality banner which has the strong support of most Americans. As Table 11 on trends in occupations suggests, this is precisely the occupational group with the most consistent pattern of growth. So the future trends are mixed but suggest considerable potential for the growth of some mainline outdoor recreation organizations.

One feels that the strong support for environmental protection by the public at large reflects the still amorphous nature of the issue. Public health is certain to be at the front of

Table 9.--Average hours per week spent in major types of activity by selected urban population groups, by race and by age--1965 and 1975.

Activity	White	Black and other races	18-25 years	26-35 years	36-45 years	46-55 years	56-65 years
	----race------		--------------------age------------------				
1965 URBAN SAMPLE							
Size of sample (number)	1,030	103	200	321	306	252	156
Total time (hours)	168	168	168	168	168	168	168
Sleep	53.4	50.9	54.3	52.5	53.1	53.9	53.6
Work for pay	31.9	36.6	32.6	29.2	33.1	33.5	35.9
Family care	26.0	23.6	21.2	30.4	25.4	24.9	20.4
Personal care	21.8	19.9	20.9	20.3	22.5	22.4	20.9
Leisure time (total)	34.9	36.9	39.1	35.6	33.8	33.4	37.1
Organizations	2.8	3.0	4.8	3.0	3.0	2.0	2.9
Media	14.8	15.7	13.9	14.6	14.5	15.3	17.3
Social life	9.3	9.1	11.3	10.3	8.4	8.6	8.1
Recreation	1.1	.6	.8	1.2	.8	.6	1.2
Other leisure	6.9	8.4	8.3	6.5	7.1	6.9	7.6
1975 URBAN SAMPLE							
Size of sample (number)	680	77	149	234	150	141	111
Total time (hours)	168	168	168	168	168	168	168
Sleep	54.5	54.8	55.4	53.9	54.7	55.4	56.0
Work for pay	30.0	30.0	27.0	33.4	34.4	31.0	20.4
Family care	21.1	17.6	15.3	21.6	20.4	23.2	23.2
Personal care	22.1	21.0	20.3	20.8	21.1	23.1	26.6
Leisure time (total)	40.3	44.6	50.0	38.4	37.3	35.2	41.8
Organizations	4.4	4.9	8.4	4.2	3.3	3.1	3.2
Media	18.7	19.6	18.5	17.2	18.3	18.8	22.6
Social life	8.2	9.8	10.7	8.7	7.8	5.4	6.2
Recreation	1.5	.4	2.6	1.3	1.0	1.3	1.3
Other leisure	7.5	9.9	9.8	7.0	6.9	6.6	8.5

uch concern, so air and water pollution, traffic jams, urban slums, industrial safety and arcinogens in nearly everything are likely to e more curcial motives than the protection of hunting area or funds to maintain a declining park system. Still the issues of parks, laygrounds and open space can feed from the eneral concern for creating a quality of life hat matches our touted wealth.

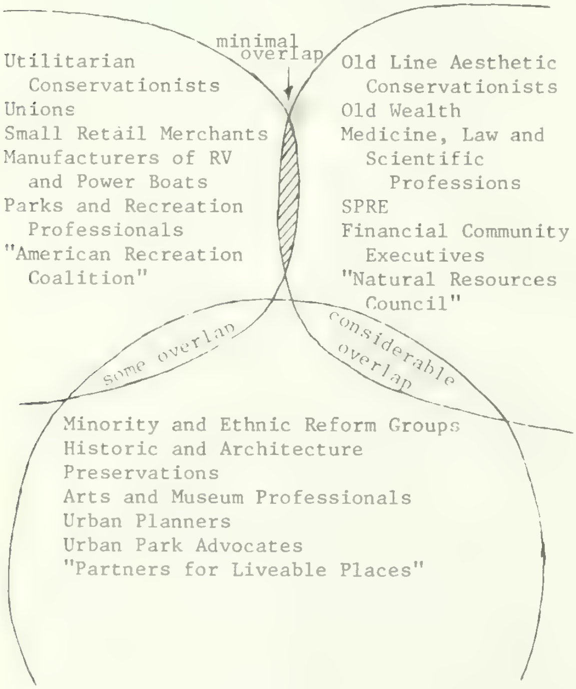
In sum, the potential threats from without and within the recreation movement seem to e leading to a series of social circles and hifting coalitions or "interorganizational onnections" as Perrucci and Pilisuk (1970) ould call them. Many of the larger preservation organizations have banded together in Natural Resources Council of America to present a united front. Another coalition of rts, urban open space and historic preservation called Partners for Liveable Places has been formed. These two groups are likely to confront a group of some fifty organizations more dedicated to active recreation, who have formed the American Recreation Coalition. Finally, there is the rapid growth in trained recreation specialists loosely joined in the National Recreation and Parks Association who distribute themselves among the three major circles (see Figure 6).

These three social circles have implicitly different lobbying agendas. The Natural Resources Council is basically opposed to development and is restrictive in regard to high quality air and water standards and use of wildlands. The "Partners" group strongly favors certain kinds of urban redevelopment. The American Recreation Coalition has a strong industrial underpinning and is likely to stress the need

Table 10.--Trends in U.S. occupations--percent of labor force in various categories: 1900 - 1975

Categories	1975	1970	1960	1950	1940	1930	1920	1910	1900
Number of workers (in thousands)	84783	78627	65778	56225	51742	48686	42206	37291	29030
Professional & technical	15.0	14.2	11.4	8.7	7.5	6.8	5.4	4.7	4.3
Managers, officials, & proprietors	10.5	10.5	10.7	8.9	7.3	7.4	6.6	6.6	5.8
Clerical	17.8	17.4	14.8	12.3	9.6	8.9	8.0	5.3	3.0
Sales workers	6.4	6.2	6.4	7.0	6.6	6.3	4.9	4.7	4.5
Craftsmen & foremen	12.9	12.9	13.0	13.8	11.9	12.8	13.0	11.5	10.5
Operatives	15.2	17.7	18.2	19.8	18.4	15.8	15.6	14.6	12.8
Non farm labor	4.9	4.7	5.4	6.1	9.4	10.9	11.6	12.0	12.5
Private household	1.4	2.0	3.0	2.5	4.7	4.1	3.3	5.0	5.4
Service workers	12.4	10.4	9.2	7.6	7.1	5.6	4.5	4.6	3.6
Farmers & farm managers	1.9	2.2	4.2	7.7	10.4	12.3	15.3	16.5	19.9
Farm laborers	1.6	1.7	3.3	4.3	7.0	8.8	11.7	14.4	17.7
Occupations not reported	---	---	---	1.3	---	---	---	---	---

Figure 6.--A representation of likely social circles in environmental and outdoor recreation movements


minimal overlap
Utilitarian Conservationists
Unions
Small Retail Merchants
Manufacturers of RV and Power Boats
Parks and Recreation Professionals
"American Recreation Coalition"
Old Line Aesthetic Conservationists
Old Wealth
Medicine, Law and Scientific Professions
SPRE
Financial Community Executives
"Natural Resources Council"
some overlap
considerable overlap
Minority and Ethnic Reform Groups
Historic and Architecture Preservations
Arts and Museum Professionals
Urban Planners
Urban Park Advocates
"Partners for Liveable Places"

for more active facilities and more liberal access by the public to open space. The NRPA, except for its sub-group, Society of Recreation Educators, is more likely to favor active over passive uses of the outdoors. The next decade should see considerable shifting of ground and a good deal of in-fighting between these various groups. We may be reasonably confident that none of these groups will accept the tourism umbrella organization--Discover America Travel Organizations, Inc.--as their political shelter. Indeed, some of these groups assume they are on a religious pilgrimage rather than simply enjoying the companionship and scenery. We may be equally confident that the Defense Department will forget more money than these groups will gain in total public investment for their favorite programs.

CONCLUSION

This paper has attempted to travel over a vast and dangerous terrain with only the most diminutive of factual cairns to guide us. We began by suggesting that the emergence of the outdoor recreation movement reflects the final transition from the age of production to the age of consumption. Unfortunately for the long run survival of our society, such a transition may have come at just the wrong time. Nevertheless, work is unlikely ever again to assume the kind of central life purpose that it had for our puritan ancestors.

We suggested that the conservation strug- e is no longer primarily between commodity ploitation and "higher values" as it is a ruggle between different conceptions of the st and highest recreational utility. We en considered how all of this might fit to the larger trends of American political ructure. We suggested that hierarchies of creational issues and organizations were erging. We concluded that population de- ines and rising inflation were not likely have as marked an influence upon member- ip patterns as were the struggles between e emerging recreation coalitions.

Be that as it may, for the first time door recreation is being self conscious out its political realities. And this can y promise an ever clearer consideration l measurement of those self-evident truths out the full human value of outdoor recre- ion resources. All confrontations with lity are painful. Yet only through them we gain hope for an improved human con- ion.

LITERATURE CITED

TA Travel News. 1980. Trends in tourism --the big picture.
tomore, T.B. 1964. Elites and society. New York. Basic Books.
oley, Richard A. 1963. Politics and conservation. New York. Harper & Row.
hl, Robert A. 1958. A critique of the ruling elite model. American Political Science Review 52:463-469.
mhoff, G. William. 1967. Who rules America? Englewood Cliffs. Prentice-Hall.
ss, Phillip O. 1960a. Politics and grass. Seattle. University of Washington Press.
ss, Phillip O. 1960b. The grazing fee dilemma. Alabama University Press.
ldman, Marshall I. 1970. The convergence of environmental disruption. Science 170 (October):37-42.
rdin, Charles M. 1967. Food and fiber in the nation's politics III. Washington, D.C. National Advisory Commission on food and fiber.
nter, Floyd. 1959. Top leadership, U.S.A., Chapel Hill. University of North Carolina Press.
kachman, Robert. 1973. To tame the monster. New York Times Magazine, February.
tchell, Robert C. 1979. Silent spring/ solid majorities. Public Opinion, pp.16
rrison, Denton E. 1980 in press. The soft cutting edge of environmentalism: why and how the appropriate technology notion is changing the movement. Robert C. Mitchell, editor, The Future of Environmentalism, Natural Resources Journal, pp. 8.
Rose, Arnold. 1954. Theory and method in the social sciences. Minneapolis. The University of Minnesota Press.

SKIING TRENDS

Charles R. Goeldner
Director, Business Research Division
University of Colorado
Boulder, Colorado

Stacy Standley
Vice President of Special Projects
Sno-engineering, Inc.
Aspen, Colorado

Abstract.--A brief historical overview of skiing is presented, followed by a review of factors such as energy, population trends, income, sex, occupation and attitudes which affect the future of skiing. A. C. Neilson's Sports Participation Surveys show that skiing is the second fastest growing sport in the country. Skiing Magazine's study indicates there are approximately 14 million active skiers in the United States. The U.S. Forest Service's nation-wide study of the skier market indicates there are another 13 million potential skiers.

Demand is increasing at a much faster rate than supply is. Regionally the West is experiencing an imbalance of demand exceeding supply, while the East and Midwest are approaching equilibrium. Without an increase in supply, skiing may suffer a decrease in popularity. The paper concludes with a list of future trends.

INTRODUCTION

Historical Overview[1]

Recreational skiing has ancient roots, with skiing being traced back to prehistoric times where man used primitive skis and sleds to cover vast snow covered areas in the Scandinavian countries. Archeological findings have placed skis in Sweden and dated them by pollen analysis at 2,000 B.C. Skiing provided a means of travel between isolated communities, provided a technique for the hunter which aided his survival in snow-bound regions, and was also used in conducting war in Norway as early as 1184 A.D. As could be expected, use of skis led to racing, and Norwegian military contests involving downhill racing were held during the late 18th Century.

The Norwegians developed steering and stopping techniques, which elevated Alpine skiing and ski jumping in Scandinavia to the high status it holds today. Skiing as a sport followed the migration of Norwegian skiers around the world. Hannes Schneider from the Arlberg region of Austria developed techniques emphasizing speed, edging and the shifting of weight from ski to ski, which made skiing easier and more attractive for the average alpine visitor. Sir Henry Lunn, an Englishman, is credited with starting the promotion of winter tourism by inviting some influential British friends to France for a winter holiday in 1898.

Skiing was further enhanced by the military use of skis and by the first Winter Olympics at Chamonix, France, in 1924. Great improvements were made in ski equipment and in the development of transportation devices to carry a skier or pull a skier uphill--rope tows, T-bars, trams and chairs. The first chair lift in the U.S. was developed in 1938 at Sun Valley and its current popularity is well-known, as it dominates uphill transportation. Ski trains became popular in Winter Park, one of the first ski areas in Colorado, when the area was reached by skiers who came through the Continental Divide via the Moffat Tunnel.

---

[1] Smith, Kenard E. Location Analysis of High-Volume Skiing in Western United States, Xerox University Microfilms, Ann Arbor, Michigan 48106, 1975, pp. 1-55.

As interest picked up in skiing, early ski resorts developed in response to the desire to ski, particularly at areas near large urban markets. A few ski resorts such as Sun Valley, were developed far from urban markets, offering complete lodging, dining and entertainment at the ski slopes--very typical of today's destination ski resorts. Eastern ski areas thrived on skiing's new popularity and efficient train service. Consequently, despite the depression, skiing grew from participation by a small hardcore group--ski jumpers and college club students--to a $200 million enterprise prior to World War II.

The post-World War II impact was dramatic. The skiing industry capitalized on new equipment developed, ranging from snow vehicles and ski clothing to improved boots and skis. The members of the Tenth Mountain Division returned to the mountains where they trained to virtually build a major industry. Approximately 90 ski areas, primarily with rope tow installations, were in existence in 1947. During the 1950s, the number of ski areas grew to over 200, and this rapid growth has continued with skiing gaining mass appeal. It is an "in" thing to do, and leading ski resorts thrive. Skiing has become not only a form of recreation, but a big business. Resorts, ski clothing, ski equipment, transportation, and real estate have all become part of making skiing a major winter recreation industry.

During the 1960s and 1970s, skiing has reached high volume proportions. The 1960 Winter Olympic games held at Squaw Valley, California, received live television coverage which greatly enhanced the U.S. public's interest in skiing. Today we find that ski areas in the United States and Canada are catalogued in the White Book of Ski Areas, published by Interski Services, P.O. Box 3635, Georgetown Station, Washington, D.C. 20007. This book lists approximately 925 ski areas with 725 being in the United States and 200 in Canada. They acknowledge that there are additional areas of a small nature, primarily rope tow, which are not listed and which do not operate consistently from year to year.

Today, in 1980 we find that skiing closed out the 1970s with a rush. Recent studies put the number of U.S. residents skiing at over 14 million. In 1976, retail sales of snow and skiing equipment totaled over $404 million. The 1977-78 ski season was the best in history all across the continent. The industry is estimated to be growing at approximately 7.5-9 percent per year. In 1978-79, Colorado led the nation in lift tickets issued, with 7,215,316. Participation in skiing has been growing at a rapid rate. The A. C. Neilson Company's Sports Participation Survey conducted in 1979 shows an overall increase of approximately 40 percent from the numbers in the 1976 study and the 1976 study was up by approximately the same amount over the 1973 study.

FACTORS AFFECTING THE FUTURE OF SKIING

There are certain basic factors that affect the market for skiing. Since these are general factors, they also affect the market for other outdoor recreation activity to an almost equal degree. Since our task is to look at trends in skiing, we will focus on these factors from a skiing perspective. Readers should recognize they may apply equally as well to other forms of outdoor recreation.

Like any other product, skiing requires people with income and a willingness to spend in order to generate successful markets. Some of the major factors that affect the market for skiing are population trends, income, sex, education, occupation, time, attitudes, fashion, custom, habit, tradition, life styles, and energy. This brief list is illustrative of major factors affecting tourism that the ski area manager must be concerned with.

Population Trends

It takes people to create a skiing market, and as we all know the population in the United States has been increasing rapidly. Although the growth rate has slowed considerably in the last decade, the numbers are still increasing and will continue to do so. As of July 1, 1975, the U.S. population was estimated to be approximately 214 million. In 1980 it is expected to be 222 million; in 1985, 233 million; in 1992, 244 million. These population numbers indicate that the trend is favorable for the future of skiing. More important to the future of skiing than just sheer population numbers is the mix or profile of ages.

Age

The age factor is probably of greater interest to ski area managers than any other population figure. Here we have both some plusses and minuses.

Teenage Segment. The teenaged population is now declining after record growth in the 1960s. Even so, this group bears close examination. This is a group from where future skiers come. While the total population in the U.S. is projected to grow about 10 percent during the next ten years, there will be something like a 7 percent decrease in the number of teenagers. In spite of this decrease, they will still number around 25 million in 1990, versus approximately 29 million today.

The Young Adult Segment. The number of people 20-34 years old is expected to increase from about 57 million in 1980 to 62 million by 1985. The 20-34 year olds who now comprise the largest segment of the adult population will still be the largest group by 1985 and will continue to dominate up to 1990. These figures make the future of skiing very bright indeed, because this is the heart of the skiing market. This is the group that is important for ski marketers to get on the slopes, as evidence shows that they will continue to ski until they are approximately 50 years of age.

The 35-49 Segment. The 35-49 year old group will increase over 30 percent to approximately 46 million in the United States by 1987. This is another very important group for the future of skiing. This group tends to heavily populate destination ski resorts and travel by air.

Senior Citizen Segment. Another major population category that deserves to be watched is the Senior Citizen group. The number of people over 65 will increase about 20 percent to 27 million in the 1980s. This group tends to be the least mobile of our population, and tends not to ski. With the increasing numbers in this segment, perhaps it deserves more attention than it has received in the past, as the over-60 age group at ski areas show relatively steady percentages. Ski area operators need to examine how these numbers can be increased.

Income

Buying power is another critical factor affecting the demand for skiing. The skier typically tends to be high scale, earning above the average income of the U.S. population. The 1977 National Travel Survey shows a direct relationship between family income and travel. Families with incomes over $25,000 per year were heavy travelers, taking almost five times as many trips as those with incomes of less than $5,000. A similar situation exists in skiing, where income correlates closely with participation in the activity.

Sex

Throughout history, skiing has been dominated by the male sex and it continues to be. However, the trend that should be observed is that more and more women are skiing, and the future will see larger and larger numbers of women on the slopes. Almost 53 percent of the adult population are women, and their longevity continues to increase. The women's movement has dramatically changed the role of women. During the past five years, the number of single adult women rose approximately 40 percent to over 8 million; 71 percent are 20-34 years old; half of them have incomes of $10,000 or more; almost half have gone to college; and almost 70 percent are working. For many women, the home has ceased to be a full-time occupation. Women have earned increasing responsibilities in the traditional work of men, leading to new levels of female education and economic and social independence. Consequently, women represent a tremendous potential for skiing.

Education

Education has always been a factor which stimulated travel. It affects skiing the same way with skiers being a very highly educated group. Trends in education show greater and greater proportions of the adult population to complete additional years of education. The Census Bureau projects that by 1990, 74 percent of people 25 and over will have four years of high school, compared to 65 percent in 1977. In 1977, 29 percent of the adult population had completed one or more years of college, while at least 33 percent are expected to have done so by 1990.

Occupation

Occupation is a factor that is closely related to income and education. There are also certain life styles associated with occupations, and this has an impact on whether individuals are likely to ski or not. Studies have shown that the occupational classification of the household head producing the greatest number of ski trips were in the professional, technical and managerial areas. The 1977 National Travel Survey shows the same occupational classifications produced the greatest number of person trips, as well. During 1970 to 1980 there was a 40 percent increase in combined numbers of professional, technical and managerial workers--twice the percentage increase for the labor force as a whole. This obviously speaks well for the future of skiing.

However, there are more workers in other occupational categories. Income is growing more quickly among lower socioeconomic strata. This group typically has not skied. However, there is no question that today they are moving into the same income classes that skiers come from. Market analysis shows that consumers no longer fit neatly into categories of income, age, sex, and occupation. Plumbers, for example, may now have the income of university professors, but their spending habits are quite different. The potential is there, however, for this market to emerge as active skiers.

Attitudes

Attitudes toward leisure and recreation have changed over the years. We have moved from a Protestant work ethic to a leisure ethic. The length of the work day in the United States has been compressed from about 12 hours to 8; the number of days worked per week has declined from 7 to 5 or even fewer; and the population's attitude toward travel, leisure and recreation has shifted from being a luxury to a necessity. It seems quite clear that future generations will view leisure quite differently than those of the past. They will view it as a right, as one of the most meaningful aspects of their lives, and this attitude change will greatly enhance skiing.

Time

Another factor affecting skiing is free time. Not only does it take money to ski, but it also takes time. The amount of free time or leisure time available to the average person in the U.S. will continue to increase, which will assist in the further growth of skiing. The practice of granting paid vacations and holidays will continue to grow, and it will be these blocks of free time that will assist the growth of the ski industry. The Uniform Monday Holidays Act provided additional blocks of time, and it is interesting to note that for most ski areas, the three-day weekend in February including President's day tends to be the peak ski day of the year. Christmas, another typical vacation period when the family is required to stay home because of school, is another major peak time.

Fashion

Fashion is another factor affecting skiing, as fashion is universal in U.S. marketing today. It applies not only to women's clothing, but virtually every product and service you can mention, including recreation and transportation. Skiing is a fashionable activity in today's society. Ski clothing has a definite fashion element. It appears that for the near term, skiing will continue to be a very fashionable and popular activity.

Energy

Energy is a factor we have not had to deal with in skiing until 1974. It is one of those irregular factors that can come into the picture and dramatically affect all the usual factors, such as population, buying power, etc. There is no question but what today one would be remiss in not talking about the energy situation as a major factor affecting skiing and other forms of outdoor recreation. The majority of skiers still arrive at the ski area by automobile. In the study, The U.S. Skiing Market: A Nation-Wide Study of Skier Behavior Attitudes and Motivations Among Alpine and Nordic Skiers, conducted by Opinion Research Corporation for Skiing Magazine in 1978, the personal car is shown as the most popular means of transportation used by eight out of ten current skiers. Each of the other means of transportation--bus, rental car and train--are used by less than four percent of skiers. Because of this, the fear of not being able to buy gasoline will be a major travel deterrent. Consequently, long-term trends that may result from energy problems are: (1) an increase in package tours and increased tour groups which are energy efficient and provide transportation security for the skier; (2) an increase in smaller, less comfortable, more energy-efficient automobiles; (3) an increase in travel to ski areas closer to home; (4) less frequent trips, but an increased length of stay.

An impact which may have considerable importance to the sport of skiing is the result of high heating costs in northern states changing the traditional school year pattern. There has been talk of having vacation time during the coldest winter months to save energy and to have four day school weeks during the winter with the times made up during milder weather. If these actions take place, it would provide additional time for ski vacations and could be a real boon for skiing. When it comes to energy priorities, it is believed that consumers will give up other activities before relinquishing their vacation and recreation activities.

Changing Life Styles

Income does not ski, occupation does not ski, education does not ski--people ski. The decision to ski or not to ski involves an intricate set of wants, needs, desires and expectations. These belong to people who are constantly changing. It is clear that skiing remains a major option for affluent, educated people to choose to occupy their free time, but skiing is only one of many options available. Today more people are concerned with self-fulfillment, trying out new life styles, and searching out new pleasures. In this environment, skiing has become a competitor, bidding against other leisure time activities for the consumer's attention and a share of his time and dollars. Today there is a great merging of recreational life styles, with little distinction between social classes, as millions of people become more financially and physically mobile. While income is still a good indicator for marketers, an analysis of income is no longer a sure guide to the patterns of recreational usage.

The ski area planner must examine and keep up with changing life styles. The fact that young adults are a growing force in our economy, with their new values and attitudes, must be analyzed. Take marriage, for example. The attitude of young people is quite different from today's 35-49 year old age group when they were young. Today's young people are getting married later, if they get married at all, and this is creating growing numbers of single people. In the past five years, the singles market has grown from 10 million adults under the age of 35, to 15 million. This enormous singles market is continuing to grow. There is also the divorced segment of the singles market, approximately 11 million people in the U.S. are divorced or separated. Recent figures indicated that there was one divorce for every two marriages. The singles life style appears to be very compatible with outdoor recreation activities such as skiing.

Conclusion

The factors that have been sampled point out that in the skiing market place it is necessary to recognize that people will change in coming decades. Their customs, values and life styles will go through the usual metamorphosis of time. If the ski area planner is to forecast trends with a profitable foresight, he must be a student of the factors affecting the skiing scene.

SKIING TREND INFORMATION

It's time to move from the general to the specific and talk directly about skiing and what has been going on in the sport of skiing. When we talk about skiing, we typically think of alpine or downhill skiing, but today with the rapid growth of cross-country skiing, it needs to be included in any analysis of the sport.

Just as skiing has come a long way from its small beginnings, so has ski research and information on the industry. For years, skiing was plagued by the lack of good information, but today we are fortunate to have a number of studies on the industry which provide valuable insights into the skier, the market place, actives, inactives, nonskiers, and potential skiers.

One of the benchmarks on the sport of skiing is provided by the A. C. Neilson Company with their 1979 Neilson Sports Participation Survey. This survey is the fourth in a series of three year measurements designed to monitor the participation of the public in major sports activities. Neilson conducted their first nation-wide sports participation study in 1970, covering 13 sports categories. In 1973 they launched their second survey, making it much more comprehensive measuring 25 sports and conducting the survey via telephone. In 1976, the third survey was conducted with the number of sports covered increasing to 27, and the project was patterned after the one in 1973 to enable trends in sports participation behavior to be traced. The 1979 survey follows the same data collection techniques that were designed in the 1973 and 1976 studies, and it covers 30 sports categories. The interviewing was performed during the March-April period, dovetailing the time of the data collection in the 1976 study. This had the advantage of holding seasonal variables to a minimum and being virtually the ideal time to collect skiing data. Consequently, Neilson's data provides an important benchmark from which to explore skiing.

In any study, it is important to learn what definitions are used, and the A. C. Neilson people note that a participant/player for the purposes of their study is defined as an individual who participates in an activity or plays a sport "from time to time" during the past year. Neilson's data indicates that snow skiing is a very popular sport increasing participation at a very rapid rate. There was approximately a 40 percent increase in participation in skiing in 1979 over 1976, on top of an approximately 40 percent increase between 1973 and 1976. This has brought current participation in this sport of snow skiing to a level of 6.8 percent among individuals, which projects to approximately 14.6 million skiers. This figure is very close to the figures published by Skiing magazine in their U.S. Skiing Market study and by the Forest Service in their Nationwide Skier survey. Slight differences in totals exist because different age groups were included, but when these differences are accounted for the study results are remarkably similar.

More important than the numbers participating is the makeup of those numbers. For example, a beer manufacturer wishes to know who his light, medium and heavy users are. The same should be true in skiing. You want to attract the heavy skiers or serious skiers to your resort. About 20 percent of the skiers account for about 60 percent of the participation. Light skiers skiing 5 days a year or less amount to about 45 percent of the participants and account for about one-eighth of the participation. Heavy skiers ski twenty days or more per year.

Important benchmarks to remember are that of the approximately 76 million households in the United States, 12.4 percent have one or more family members who ski. This is up from 1976 when the incidence was 8.6 percent. On the average, each skiing household contains 1.6 members who ski.

Highlights show that the average downhill snow skier has been skiing for over six years, and cross-country participants have been skiing for about 3.75 years. In 1976 downhill skiers averaged slightly over six years of activity in skiing. The number of miles traveled in order to reach snow ranged from less than one mile, to 1,000 miles or more, with the average one-way trip representing a distance of slightly over 200 miles. This compares to a similar average of nearly 200 miles in 1976. Cross-country skiers do not travel quite as far--an average of 83 miles. The automobile continues to be the primary mode of transportation used to travel to the downhill snow skiing area, at 87 percent, while 73 percent of the cross-country skiers use the automobile. Each downhill trip lasts an average of nearly three days, while cross-country skiers average about 1.7 days per ski trip.

Fourteen percent of the downhill snow skiers and 24 percent of the cross-country skiers stated that they purchased skis during the past 12 months. The average price for a pair of downhill skis was $170, while the average price for a pair of cross-country skis was $90.

Another benchmark study was the previously mentioned U.S. Skiing Market Survey conducted for Skiing Magazine by Opinion Research Corporation. This study found that almost 10 million adults do some snow skiing each year, either Alpine or cross-country or both. In addition, there are over four million teenaged snow skiers, for an overall total of almost 14 million people aged 12 or over who skied during the 1976-77 season. They found that 58 percent of all adult skiers are male, and 42 percent are female. Skiers who ski alpine exclusively account for 72 percent of all skiers, while 11 percent engaged in cross-country only, and the remaining 17 percent skied both alpine and cross-country.

Skiing enthusiasts are demographically different from the total U.S. population, as has been shown in many other studies. For example, their study showed that males account for 59 percent of all Alpine skiers, 53 percent of all cross-country skiers, but only 48 percent of total U.S. adult population. Approximately one-half of all skiing enthusiasts are single, compared to only one in five U.S. adults who are single. Approximately seven out of ten adult skiers are under 30, but only three out of 10 adults in the U.S. population are under 30. The skier has a higher level of education; approximately 20 percent of alpine skiers and 30 percent of cross-country skiers have achieved post-graduate levels of education, while less than 10 percent of adults in the total U.S. population have done any post-graduate work. Skiers also have high income levels compared to the U.S. population, with 32 percent of alpine skiers and 26 percent of cross-country skiers living in households with $25,000 and over annual income, while only 16 percent of the total population live in such households. Employment dovetails income, and skiers tend to hold more prestigious occupations; approximately 60 percent of skiers are in a professional or managerial capacity while less than 30 percent of employed adults in the U.S. are in professional/managerial occupations.

This survey also covered motivations for skiing, which it grouped into three major categories: (1) those related to health/esthetic factors; (2) activity/sports related factors; and (3) personal/social factors. The three types of factors were about equally important to Alpine skiers while the health/esthetic factor was by far the most important to cross-country skiers. Skiing is a social activity, and the Skiing magazine survey points out the importance of this, revealing that six out of ten skiers were introduced to skiing by friends and almost four out of ten by family members.

It is common in ski surveys to ask skiers to classify themselves according to their level of experience or ability. This is always an interesting exercise and one wonders how the rating would compare with an instructor or a ski patrolman's. In any event, in the Skiing magazine survey, 25 percent of the Alpine skiers classified themselves as beginners, 25 percent as intermediates, and 50 percent as advanced or expert.

Well over 50 percent of the Alpine skiers took overnight skiing trips during the 1976-77 season and averaged close to eight skiing trips during the 1976-77 season, while cross-country skiers averaged over nine trips. Alpine skiers spent an average of 11 days, and cross-country skiers approximately 13 days, on skiing trips. As mentioned previously, the personal car is the most common means of transportation to the ski area, being utilized in 82 percent of the cases.

The three leading states for Alpine skiers were Vermont, New York and Colorado, while the three leading states for cross-country skiers were Vermont, New York and New Hampshire. There were 6.5 million skiing households with one or more adults during the 1976-77 season. The average expenditure by these households on ski trips was $395, for a total expenditure of approximately $2.6 billion. Transportation and lodging each accounted for 25 percent of the total household expenditures on skiing trips, with fees, lifts and rentals accounting for 29 percent; and food, beverage, amusement, etc., accounting for the balance of 21 percent. Six percent of the skiers feel that the cost of skiing in the past five years has increased less than most things they buy, while 63 percent feel that it has increased as much as most things they buy, and 31 percent feel that it has increased more than most things purchased.

The Skiing Magazine survey also included information on past skiers. They estimated that there were 7 million past skiers--adults who skied during the four-year period of 1972 to 1976 but did not ski during the 1976-77 season. Comparing past skiers to current skiers, both differences and similarities showed up. The main differences were in sex, marital status and age, with past skiers more likely to be female (48 versus 42 percent); married (58 versus 42 percent); and over age 30 (37 versus 29 percent). There were no noticeable differences in education, income and employment. The past skier had been active in the market for approximately six years, and about half of them were at the intermediate or higher skiing level. Past skiers most often cited expense, 43 percent, and time, 36 percent, as their reasons for not having skied last season. Close to one-third of the past skiers reported not having skied because ski conditions were not good enough in the 1976-77 season. Fifty-five percent of the past skiers planned to resume their skiing during the 1977-78 season.

A final area explored was leisure time activities. This showed that the skier is a physically active person who engaged in numerous leisure time activities. The most popular other activity was swimming, followed by bicycling and tennis. In comparing the segments of the skiing market, the serious alpine, other alpine and cross-country skiers, all of them favor the same top five leisure time activities: swimming, tennis, bicycling, camping and fishing.

Another benchmark study is the Growth Potential of the Skier Market by the U.S. Forest Service, a nation-wide study of the skier market conducted cooperatively in 1978 by the Northeastern Forest Experiment Station, U.S. Forest Service, under contract with Sno-Engineering Inc. and Opinion Research Corporation. This telephone survey in the spring of 1978 provided data from 2,191 active, potential, and inactive skiers drawn from 7,106 households. This comprehensive examination of skiing includes regional descriptions of the present skiers, former skiers and people who would like to take up skiing in the future. It also provides estimates of the sizes of the various skier market segments, detailed descriptions of public images and attitudes toward skiing, its cost, attractions, facilities and market needs.

This study essentially verified the results of the earlier studies regarding the number of active skiers in the U.S. In 1978, 11.2 million individuals considered themselves downhill skiers and another 1.7 million stated they were cross-country skiers, equalling a total of 12.9 million active skiers 16 years of age and over.

The inactive skiers were broken down into two groups: (1) the permanently inactives, and (2) the temporarily inactives. Among the latter group there were identified 6.4 million downhill skiers and 400,000 cross-country skiers, for a total of 6.9 million. This figure is over one-half as large as the active skier base.

The third major class, the high potential skier, was persons 26 years old or younger who expressed a strong interest in skiing and had friends who skied. A total of 7.3 million persons were identified as having a high probability of trying either downhill or cross-country skiing.

Collectively as many as 27.1 million people could be skiing in the future. This would represent an increase of over 100 percent in the number of currently active skiers. See Table 1.

The mobility of skiers has an important bearing on the future demand. Based upon the U.S.F.S. study, skiers in the East and West tend to ski within their region. Southern and Midwestern skiers visit areas out of their own region. About 80 percent of Southern skiers skied in areas other than the South in 1977-78. Thirty-nine percent visited the West and 32 percent skied in the East. Thirty percent of the Midwestern skiers went out of region to ski during the 1977-78 season, with 22 percent skiing in the West and 8 percent visiting the East. During that season, the West accounted for 43 percent of all vacation skier visits, while the East (32 percent) and Midwest (19 percent) hosted the bulk of the remaining

Table 1.--Regional distribution of major skier market classes and skier days, 1977-78

	West	North Central	South	Northeast
Potential[a]	20%	30	34	16%
Active	31	25	14	30
Inactive[b]	31	25	20	24
Skier Days	38	15	3	44

[a] High potential only.
[b] Temporarily inactive only.

visits. The implication is that the West is the most highly used ski region of the country and among potential skiers it is the most frequently mentioned region in which this class of skier would like to ski.

SUPPLY OF SKIING

Introduction

As has been discussed in the previous section, the latent or potential demand as well as the existing demand for skiing as expressed by psychographics is very strong. Such factors as disposable income, competing activities, life style changes and age cohort shifts may act as mitigating forces holding back the realization of only the most optimistic projection for skier growth. However, the most severe constraint on demand will not come from the demand side of the equation at all, but rather from the supply side--the ski facilities being unable to meet the potential increase in skier activity. In assessing the future growth of skiing, capacity and utilization of existing areas must be considered as well as the probability of new areas coming on line with additional capacity.

A ski area is similar to an airplane--once the plane has left the ground, the empty seats can't be sold. Likewise, unused capacity that existed on a Saturday on a ski hill can't be saved for Sunday. Ski area capacity is a function of a multitude of variables: length of season, quality and quantity of snow, proximity to metropolitan areas, mountain terrain, capacity, lift capacity, availability of lodging and weather. All of these elements may cause a downward adjustment of the design capacity of an area.

Ski areas are capital intensive facilities that require long lead times for design, approval and construction. Historical performance of ski areas has not been good enough to promote a strong and active investment pool for new areas. Energy, environmental consciousness, lack of competitively attractive sites and the high cost of capital are all potential deterrents to new area development.

Two questions arise which have a strong bearing upon the future growth of skiing. The first, "Does existing capacity meet the projected demand for skier visits?" Secondly, "Is the demand great enough to encourage developers to take the risks necessary to bring new areas on line?"

Historical Supply

In 1960 there were approximately 240 ski areas in the U.S. By 1968 the number had grown to 600, an increase of 360 areas or 150 percent in eight years. However, in the next ten years between 1968 and 1978 only 100 new areas were built. The 12 percent per annum growth rate which produced an average of 45 new areas per year during the early 1960s leveled off rapidly after 1968 and slowed to 1.5 percent per annum and 10 new areas annually through 1978.

In 1960 38 percent of the areas were in the East, 15 percent in the Midwest and 47 percent in the West. By 1968 with the rapid development of new areas, 52 percent of all areas were in the East, 17 percent in the Midwest, and only 31 percent in the West. Ten years later the percentages remain approximately the same due in part to the decreased activity in area development and also to the greater capacity of the Western areas.

The total number of ski areas expresses the availability of opportunity. If the number of areas is defined geographically, the relationship between ski areas and population centers can be generally related. However, while the number of new areas added over time may express the relative interest in ski development, it does not define the change that occurs in skier capacity. A more precise measurement tool is required if we are to accurately portray the increase in capacity as well as the geographic distribution of that capacity.

The most explicit measurement would come from the execution of a comfortable carrying capacity (CCC) analysis of each new area as well as each expanded area. Unfortunately, the data base does not exist in sufficient detail to undertake this approach, whereby the lift capacity, trail acreage and round trip interval of the skier are evaluated to arrive at an area's CCC.

Vertical Transport Feet per Hour (VTFH)[2] and total number of lifts installed provide a measure of capacity though not as definitive as CCC. Analysis of lift construction figures over the past 20 years provides a benchmark for evaluating the growth in capacity as it relates to the geographic dispersion of lifts. Coupled with VTFH, a fairly accurate picture of the industry's growth can be drawn.

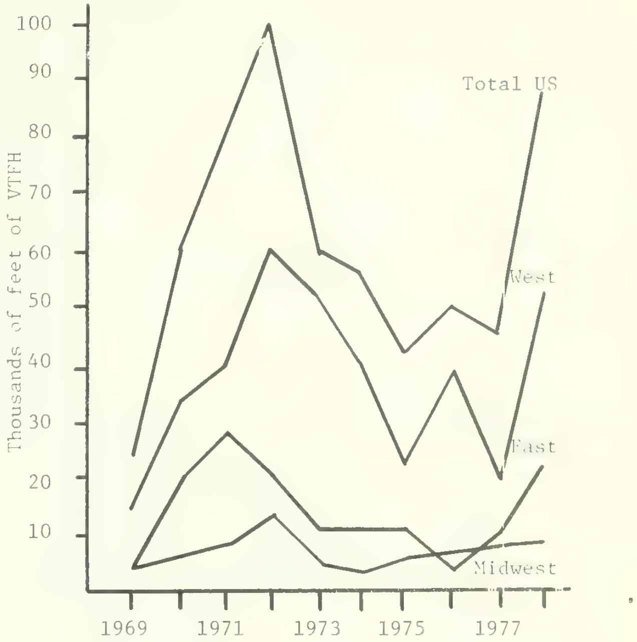
Table 2, Historical Growth of Ski Lifts, depicts the last two decades activity of new ski lift development by region. During the nine-year period from 1960-1968, 1,140 new lifts were built, an average of 143 lifts per year. During the next 10 years, only 995 lifts were added, or 100 per year, a decrease of over 30 percent per year. The initial thrust of development activity (1960-1968) took place in the East where a 10 percent increase in total share of lifts was realized at the expense of the West during the period. By the end of 1978 the West's growth had once again outpaced the East's, as had the Midwest's, and the distribution of lifts was equal East and West, each accounting for 41 percent.

Table 2.--Historical growth of ski lifts.

	1960		1968		1978	
	#	%	#	%	#	%
East	175	36%	740	46%	1,067	41%
Midwest	75	16	250	15	464	18
West	225	49	625	39	1,079	41
Total	475		1,615		2,610	

VTFH is an expression of the quantity of uphill capacity provided by a lift or system of lifts. It therefore is the best estimate of the capacity increases that have occurred over time. From 1969 through 1978, 618,800 VTFH were added to the supply of U.S. skiing. Figure 1, Ten Year Growth Summary of VTFH, demonstrates the rate of growth by region that has occurred over the 10-year period. During this period the West has been adding an average of 12 lifts per year more than the East, and as is shown in the figure, the West added 150 percent more VTF during the period. The average capacity per new lift in the East was 579 VTFH, while in the West it was 983 VTFH per lift.

Figure 1.--Ten year growth summary of VTFH



Source: Various Ski Area Management magazines.

The sharp rises and falls of new VTFH construction by year demonstrates the industry has not added capacity at a steady rate either nationally or regionally. In attempting to correlate added VTFH/year with new areas coming on line, it was revealed that only in a very general way was there a positive relationship between the two. When many new areas were built, the average VTFH per area tended to be low. On the other hand, in years when few areas were added (as was the case in the middle 1970s) the average VTFH per area was much greater. New lifts at existing areas as well as replacement of old lifts diminish the total capacity increase as a result of additional VTFH.

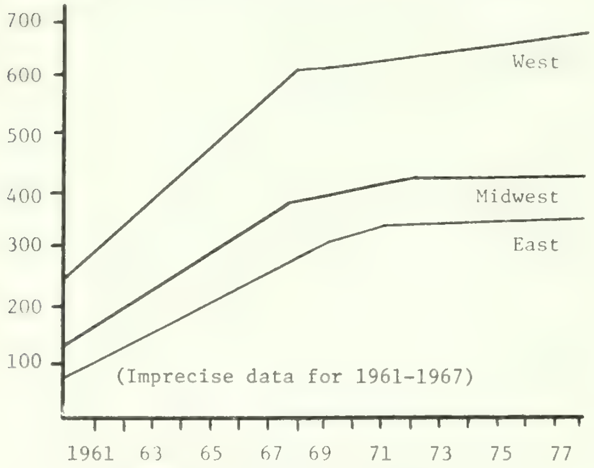
This factor when coupled with the lack of a smooth growth curve VTFH suggests that the supply of skiing has not been empirically responsive to demand. Rather exogenous variables, such as availability of investment capital, expansion potential of existing areas, good snow years, Federal and local governments, approval of new areas and developer interest are factors contributing to the expansion of capacity.

Figure 2, Ski Area Development 1960-1978, depicts the growth and distribution of ski areas in the U.S. Coupled with Figure 3, Ski Lift Inventory 1960-1978, the picture of the historical development and current supply of ski facilities in the U.S. is portrayed.

---

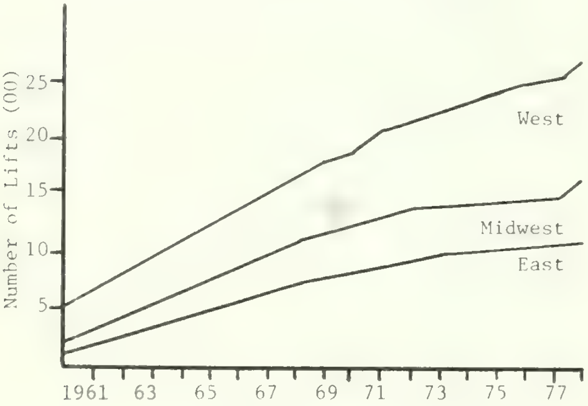
[2] Vertical transport feet per hour--the number of skiers who can be transported 1,000 feet in one hour.

Figure 2.--Ski area development, 1960-1978.



Source: Various Ski Area Management issues, Sno-engineering, and U.S.F.S.

Figure 3.--Ski lift inventory, 1960-1978.



Source: Various Ski Area Management issues, lift manufacturers, and Sno-engineering.

Utilization

Understanding utilization of facilities is paramount to determining the need for additional capacity. It is also extremely difficult to define and accurately measure. The number of variables considered is great and the precision with which some of them can be measured is no better than judgmental. One must consider: total acreage of ski terrain, density per acre of skiers by ability class, ability of lift systems to transport skiers, length of season, length of day, quality of snow, VTFH required by various skill levels of skiers, waiting time in lift lines, number of down days per season and availability of night skiing just to highlight the list.

The Forest Service has developed a scheme for estimating daily and seasonal capacity that is a reasonably good general model useful for analyzing the demand supply relationship. Under the U.S. Forest Service model, uphill capacity, slope capacity, food and beverage capacity and parking lot capacity are evaluated, calculated, and consensus daily capacity estimates derived. To arrive at seasonal capacity the 100 days generally agreed upon as constituting the "high season" (the period from December 16, 1978-March 25, 1979, for example) is multipled by the daily capacity to yield a seasonal capacity estimate. Within the truncated season are two time periods which historically exhibit different use characteristics--weekdays comprising 71 percent of the season and weekends comprising 29 percent of the season.

The truncated season may, in fact, represent the entire season in some years for certain regions of the country such as the East and Midwest. In other parts of the country, primarily the far West, the truncated season may represent only 60 percent of the total season. An evaluation of utilization of areas during the truncated season by weekend and weekday as well as a comparison of the percent of total visits accommodated during the truncated season to the entire season produces an estimate of total utilization. Discussion of this analysis in light of future demand will begin to permit insight into future supply requirements needed to yield a balanced supply-demand equation for downhill skiing.

In Table 3, Analysis of Truncated Season, a representative sample of ski areas operating on U.S. Forest Service land is enumerated along with the operating characteristics of the areas during the truncated season. A selection of those areas and their operating characteristics are included in Table 4, U.S.F.S. Ski Area Operating Characteristics, in order to highlight the key findings of the skier visit data.

In the East and Midwest the 29 percent of the truncated season occurring on weekends produced an average of 50 percent of all skier visits. Those areas with destination skiing tended to have a lesser proportion of their skier visits occurring on weekends. Weekend utilization rates in the East fell in the 55-65 percent range and weekday utilization was in the mid- to high 30 percent

Table 3.--Analysis of truncated season.

Area	Percent of Skier Visits Occurring on Weekends	Percent of Total Skier Visits	Area	Percent of Skier Visits Occurring on Weekends	Percent of Total Skier Visits
California			Michigan		
Holiday Hill	41%	89%	Caberfae	48%	95%
Sierra Ranch	48	80	Indianhead	50	85
Kirkwood	46	75	Blackjack	66	93
Mammoth	44	73	Minnesota		
Heavenly Valley	38	85	Lutsen	54	90
Washington			Colorado		
Alpental	48	92	Loveland	50	63
Crystal Mountain	56	82	Vail	33	86
Mt. Baker	74	83	Aspen	28	89
Ski Acres	47	88	Eldora	43	73
Oregon			Purgatory	41	88
Mt. Bachelor	47	76	Copper Mountain	39	85
Mt. Hood	49	91	Montana		
Multorpor	56	98	Red Lodge	53	76
New Hampshire			Big Mountain	38	80
Mt. Attitash	46	100	Big Sky	40	85
Loon	56	98	Wyoming		
Waterville	44	89	Medicine Bow	64	82
Wildcat	52	88	Jackson Hole	42	92
Bretton Woods	52	100	New Mexico		
Cannon	48	100	Taos	39	81
Gunstock	47	100	Red River	43	93
Maine			Sierra Blanca	50	87
Sugarloaf	50	93	Arizona		
Vermont			Arizona Snow Bowl	44	90
Bromley	46	92	Utah		
Mt. Snow	48	96	Brianhead	50	84
Sugarbush	35	98	Alta	40	71
Mt. Mansfield	35	98	Snowbird	36	71
Killington	42	90	Idaho		
			Sun Valley	32	91

Table 4.--U.S.F.S. ski area operating characteristics.

Region/Area	Skier Visits on Weekends	Weekend Utilization	Weekday Utilization	Overall Utilization	Total Visits Truncated Season
East					
Sugarbush, VT	35%	49%	39%	41%	98%
Loon Mountain, NH	56	69	35	45	98
Sugarloaf, MA	50	56	35	45	93
Cannon Mt., NH	48	50	23	31	100
Killington, VT	42	65	39	47	90
Midwest					
Indianhead, MI	50	71	29	42	85
Caberfae, MI	48	66	28	40	95
Lutsen, MN	54	86	30	47	90
West					
Aspen, CO	28	56	61	59	89
Vail, CO	33	102	87	92	86
Snowbird, UT	36	68	53	57	71
Mammoth, CA	44	88	48	60	73
Heavenly Valley, CA	38	71	49	55	85
Mt. Baker, WA	74	246	37	100	83

Source: U.S.F.S. Pricing Study Printout, August 1979.

range. Overall utilization levels were in the mid-40 percent range. Generally, the East is in a position of having excess skiing capacity over the entire season with weekday capacity allowing for more than a doubling in skier visits. It is apparent that the length of season in the East generally coincides with the 100-day truncated season and little opportunity to accommodate skiers outside this time period exists.

In the Midwest, weekend use of the areas was high and the weekday utilization extremely low. The net effect is that overall utilization was about the same as experienced in the East during the 1978-79 season. The greatest opportunity for accommodating additional skiers in the region occurred during the week when more than a doubling of skier visits can be realized before excessively high utilization would result. A secondary opportunity for additional skier visit accommodation would be to increase the use of the shoulder seasons on either end of the truncated season. Based on a rather limited sample of the Midwest areas (only those operating under U.S.F.S. leases) the supply of available skiing appears to be adequate to meet the current and projected demand assuming a shift in demand away from weekend use can be effected.

The West, as would be expected, is the most difficult region to assess. The large geographic distribution of ski facilities coupled with the complex nature of the skier mix makes generalization of the regions ski facility analysis inappropriate. Those areas serving a predominately local day skier market exhibited characteristics similar to those experienced in the East and Midwest--a large proportion of overall skier visits occurred on weekends and weekend utilization rates were so high as to virtually preclude additional skier visits on weekends. Several areas in Washington, in addition to the example of Mt. Baker, realized greater than 100 percent utilization on weekends. Many of the California areas had mid-80 percent to low 90 percent utilization of facilities. In Colorado, Vail operated at 102 percent weekend use and most other front range areas operated above 80 percent on weekends.

Several destination areas realized higher midweek utilization and decreased weekend use. This is a result of the destination skier arriving on the weekend and not starting skiing until Sunday or Monday. At areas such as Aspen, weekend skiing accounted for only 28 percent of the total visits to the area. The destination areas in the West achieved better than 60 percent utilization during the weekday period. These areas will find it difficult to increase weekday skier visits in the future.

Overall utilization for all types of areas in the West was generally found to be greater than 50 percent and at least 15 percent higher than in the East and Midwest. The percent of skier visits occurring within the truncated season was low enough to suggest that some limited growth in demand could be accommodated during the shoulder seasons.

Because of the same list of variables enumerated above regarding establishment of capacity such as snow conditions, equipment shutdowns, and difficulty of redirecting skier behavior to go skiing early and late season, 60 to 70 percent utilization is generally accepted as full utilization. Based upon this standard many areas have no excess capacity for future demand. The ski areas of the West have reached the situation where many of them have achieved effectively full utilization.

This region of the country has become the major supplier of skier visits for the demand created nationwide. If skier behavior continues to dictate Western skiing as the norm, additional facilities will be required to meet the future demand. If, on the other hand, and it seems unlikely, skiers can be persuaded to ski within their region--especially the Midwestern skier, then in the short run (3 to 5 years) existing capacity in the West along with new facilities to be discussed subsequently will be adequate to accommodate the anticipated growth nationwide.

New Development

In the next five years, daily capacity in the West could increase by 30,000 skiers per day through the development of five major areas and expansion of many existing facilities. If this projected new daily capacity comes on line, three million additional skier visits during the truncated season and as many as 600,000 skier visits during the shoulder season could be realized. The potential for several other areas presently in the planning stages to be developed exists. However, with the exception of Beaver Creek near Vail, Colorado, no other proposed Western area is a certainty. A myriad of issues cloud the future development of skiing in the U.S.

Constraints to Development

As has been noted, 1969 marked the leveling out of the rapid growth of ski facilities. The year the National Environmental Policy Act (NEPA) went into effect was also 1969. This single piece of legislation heralded a new era in the U.S. and one that has had significant impact upon ski area development in the country. The environmental consciousness that has grown over the last ten years has placed new ski area construction in limbo all over the West. Questions are being asked, the answers to which often signal the demise of a new area proposal.

Through the Environmental Impact Statement Process, proscribed by the NEPA legislation, government agencies (primarily the U.S.F.S.) are being held accountable to the general public for all decisions regarding ski area expansion and new area development. No longer does an area operator sit down with the forest supervisor and prepare a plan for his area. The would-be developer since 1969 has had to enter into the NEPA process and be prepared to spend five or more years and invest upwards of $1 million to reach a "go" or "no-go" decision.

All over the West the last decade has witnessed major new development proposed only to see them denied. In California, San Gorgonio, Mineral King and Moses Maggie have been turned down. Independence Lake is apparently headed towards the same fate. In Montana Ski Yellowstone successfully weathered the protests raised through the EIS process after nearly nine years, only to find the backers so strung out by the effort the project is in jeopardy of moving ahead. Heritage Mountain near Provo, Utah, has experienced similar problems in getting off the ground.

In Colorado the score card stands at one success and several losses with uncertain outcomes on many other proposals. Beaver Creek will open eight years after it was initially proposed. Little Annie, on the backside of Aspen Mountain, was first proposed in 1965, after entering into the Colorado Joint Review Process in 1978 a decision will be forthcoming by 1982. The Hospital Building and Equipment Corporation proposed Adam's Rib near Eagle, Colorado, in 1973. Six years and $15 million later the project is at a virtual standstill. The Aspen Skiing Corporation, operators of four areas in Colorado, made the decision that no new areas were going to be approved in Colorado and began development of Early Winters in Washington. After five years the project was abandoned and the company took the development dollars to British Columbia where they will open the first phase of a 14,000 skier per day mountain in 1980, only four years after embarking upon the project.

The ten-year effect of the NEPA legislation has been to effectively stop ski area development on Federal land since 1971. This has occurred at a time when demand for skiing has been growing at 8-10 percent per year.

Recently a potentially more restrictive action was mandated by Congress--Rare II. Conceptually, Rare II, the Roadless Area Review and Evaluation program was based on a sound premise--inventory and evaluate U.S. Forest Service lands for Wilderness Consideration. Some 46,948,000 acres were evaluated and now are in a state of "defacto wilderness" until the management decisions are completed. The impact of Rare II has been to withdraw millions of acres of Federal land from consideration for ski area development. The myriad of conditions necessary for a successful ski facility hinge upon one virtually immutable key element--suitable terrain. Sno-engineering has inventoried ski terrain over the entire U.S. and Canada for over 25 years and its President, James Branch, has concluded that less than 0.1 percent of the mountainous terrain of the U.S. and Canada is suitable for commercially viable ski area development. Potential new ski sites are less likely to be found than new Wilderness areas. Yet identification of ski potential was not a charge of the Rare II program. Skiing was treated as a residual consideration in reaching recommendations for land use, but site inventories were not carried out as part of the Rare II process.

The NEPA, Rare II and a new-found consciousness directed towards environmental preservation has in ten years virtually brought ski area development to a standstill in the Western U.S. This has occurred at a time when strong demand for facilities has been documented through numerous studies. Additional demand has been directed towards the region most able to provide skiing--the West. The result of the demand curve's upslope and the supply curve's flattening has been overcrowding of existing facilities and a crushing pent-up demand for new areas. With 14 million skiers and approximately 700 ski areas, at present, there is one area for every 20,000 skiers.

Future Prospects

Demand has outstripped supply on a national basis. The Midwest and East appear to have sufficient capacity to meet regional demand for the next three to five years. In the West the need for immediate and major new facility development is apparent.

Without new development which if approved today could not come on line before 1983-84, the East and Midwest will be over capacity in less than five years and millions of potential skiers will have been involuntarily rechanneled into other leisure time activities.

Ticket prices will most likely continue to increase at least the historical 7.9 percent rate due to the over demand that will continue to exist, and the increased operating costs that will be incurred by areas as a result of over-use and crowding of present facilities.

Cross-country skiing will increase in popularity in part because of the limited availability of downhill facilities and rising costs. Energy conservation measures may spur interest in cross-country skiing because of the ready access of ski touring terrain in many parts of the country. Emphasis on U.S.F.S. planning should focus on winter use of trails, picnic areas and campgrounds. Increase conflict between user groups primarily snowmobiles and cross-country skiers will become a major management problem in the future. Greater winter facilities and operating budgets will be required to meet the increased use of the forests by ski tourers.

The concept of winter multiple recreation use of federal lands will become increasingly important over the next five years. Planning and budgeting to accommodate this demand should have begun five years ago. A method to investigate the national priority that should be placed upon downhill ski development should be devised and implemented quickly.

HIGHLIGHTS AND TRENDS

The paper has covered a great deal of information on current trends in the demand for and supply of skiing. This section concludes the paper, highlighting some of the more notable findings and trends.

1. Skiers are demographically different from the U.S. population. Ski studies show males account for about 60 percent of the skiers and 48 percent of the adult population; about one-half of skiers are single, but only 20 percent of U.S. adults are single; about 70 percent of the adult skiers are under 30, while only 30 percent of the U.S. adult population is under 30; about 20 percent of adult skiers have post-graduate education, compared to less than 10 percent of the U.S. adult population; and about one-third of the alpine skiers live in households with $25,000 and over annual income, while only 16 percent of the total population live in such households.
2. Present population and demographic trends favor the continued growth of both downhill and cross-country skiing.
3. The dramatic increase in singles will continue to boost the skiing market.
4. Women will move into skiing in greater and greater numbers.
5. Downhill skiing will continue to grow by 7 to 10 percent per year over the next five years.
6. The participation rate in the sport of skiing will continue to rise. The long-run growth of the industry will depend on increasing the participation rate as there will be a substantial decrease in the teenage segment of the population which has been feeding large numbers into the sport.
7. Cross-country skiing will grow at a faster rate than downhill skiing. As new equipment, clothing, etc., continue to develop, the growth of cross-country skiing will mirror that of downhill skiing in the 1960s. New cross-country ski centers and more abundant supply will spur this growth.
8. The fastest growing ski market in the country is the South.
9. The closer people live to skiing, the more likely they are to ski.
10. The automobile will continue to be the major method of transportation to the ski area; however, energy considerations will make air become a more important mode of transportation for the destination skier. Fly/drive packages will become more common.
11. The demand for skiing is outstripping supply. Utilization of ski areas will increase until limitation plans will have to be developed to match capacity with skiers.
12. Future supply will be constrained by environmental legislation, lack of capital and government regulation, and will not keep up with demand.
13. The West is the most highly used ski region in the country and the most frequently mentioned as the place potential skiers would like to go. The West must have expansion if growth in demand

is to be satisfied.

4. The Eastern and Midwestern ski areas can accommodate limited growth in activity.

5. The U.S. society is moving from a "work ethic" to a "leisure ethic." The youth of the country are demanding recreation and leisure as a right. Consequently, winter recreation planning is necessary if land use management policies are to be responsive to demand created by all user groups.

RECOMMENDED REFERENCES

1. THE AIRLINE SKIER: 1977-78 SEASON. C. R. Goeldner. Business Research Division, Graduate School of Business Administration, University of Colorado, Campus Box 420, Boulder, Colorado 80309. 1978. 77p. $15.

2. THE AMERICAN SKIER IN CANADA. Contemporary Research Centre Limited, Toronto, Ontario, Canada. March 1972. 73p. plus appendix.

3. AN ANALYSIS OF THE MAINE SKIING INDUSTRY. Alvar K. Laiho and Thomas A. Palmberg. Maine Department of Economic Development, Research and Analysis Division, Augusta, Maine. April 1972. 91p. plus appendix.

4. ASPEN IN ROOM SURVEY, 1978-79. C. R. Goeldner and Jack Harrington. Business Research Division, University of Colorado, Campus Box 420, Boulder, Colorado 80309. 1979. 173p. $100.

5. THE ASPEN SKIER: 1977-78 SEASON. C. R. Goeldner, Business Research Division, University of Colorado, Campus Box 420, Boulder, Colorado 80309. 1978. 80p. $15.

6. BIBLIOGRAPHY OF SKIING STUDIES. C. R. Goeldner and Karen Dicke. Business Research Division, University of Colorado, Boulder, Colorado 80309. 1978. 62p. $10.

7. THE BRECKENRIDGE SKIER. C. R. Goeldner and Yvonne Sletta. Business Research Division, University of Colorado, Boulder, Colorado 80309. 1975. 67p. $10.

8. THE BRITISH COLUMBIA SKI INDUSTRY AND ITS ECONOMIC EFFECTS. British Columbia Department of Travel Industry, Parliament Building, Victoria, British Columbia, Canada V8V 1X4. October 1974. Various paging.

9. COLORADO SKI AND WINTER RECREATION STATISTICS, 1978. C. R. Goeldner and Karen Dicke. Business Research Division, University of Colorado, Boulder, Colorado 80309. 1979. 117p. $20.

10. THE COLORADO SKIER: 1977-78 SEASON. C. R. Goeldner. Business Research Division, University of Colorado, Boulder, Colorado 80309. 1978. 92p. $25.

11. COLORADO WINTER RESOURCE MANAGEMENT PLAN: MANUAL FOR THE COLORADO REVIEW PROCESS AND IMPACT ANALYSIS GUIDELINES. Division of Planning, Department of Local Affairs, 1313 Sherman Street, Denver, Colorado 80203. August 1976. 54p. Free.

12. CONFIDENTIAL REPORT ON THE SPORT OF SNOW SKIING. Nielsen Custom Research Service, A. C. Nielsen Company, Nielsen Plaza, Northbrook, Illinois 60062. 1979.

13. CONFIDENTIAL REPORT ON THE SPORT OF SNOW SKIING. Nielsen Custom Research Service, A. C. Nielsen Company, Nielsen Plaza, Northbrook, Illinois 60062. 1976. $750.

14. THE COPPER MOUNTAIN SKIER, 1978-79. C. R. Goeldner and Jack Harrington. Business Research Division, University of Colorado, Boulder, Colorado 80309. July 1979. 68p.

15. ECONOMIC ANALYSIS OF NORTH AMERICAN SKI AREAS: 1977-78 SEASON. C. R. Goeldner and Ted Farwell. Business Research Division, Graduate School of Business Administration, University of Colorado, Boulder, Colorado 80309. 1978. 140p. $30.

16. THE ECONOMIC IMPACT OF THE COLORADO RESORT INDUSTRY: AN ANALYSIS OF COUNTY PERSONAL INCOME. Cheryl Fellhauer. Business Research Division, University of Colorado, Boulder, Colorado 80309. January 1977. 47p. $25.

17. THE ECONOMIC IMPACT OF A RECREATIONAL DEVELOPMENT AT BIG SKY, MONTANA. Ancel D. Haroldsen. Montana Agricultural Experiment Station, Montana State University, Bozeman, Montana. April 1975. 27p.

18. EFFECT OF TRAVEL CONSTRAINTS ON THE DISTRIBUTION OF SKIING IN NEW ENGLAND. Marvin Kottke and Stephen Libera. Storrs Agricultural Experiment Station, College of Agriculture and Natural Resources, University of Connecticut, Storrs, Connecticut 06268. November 1975. 19p.

19. EXPLORATION OF U.S. SKIER ATTITUDES TOWARD CANADIAN SKIING AND SKIING IN GENERAL. Market Facts, Inc., 100 S. Wacker Drive, Chicago, Illinois 60606. 1978. 65p. plus appendices.

20. GROWTH POTENTIAL OF THE SKIER MARKET. W. F. La Page and Stacy Standley. Northeastern Forest Experiment Station, Forest Service, U.S. Department of Agriculture, 370 Reed Road, Broomall, Pennsylvania 19008. October 1978. 60p. plus appendices. Preliminary draft.

21. THE IMPACT OF THE VAIL SKI RESORT: AN INPUT-OUTPUT ANALYSIS. Stacy Standley, III. Business Research Division, University of Colorado, Boulder, Colorado 80309. 1971. 91p. $10.

22. LIFT INTERVIEW STUDY OF THE ASPEN SKIER. Stacy Standley, III. Tourism Research Associates, 2118 26th Avenue, San Francisco, California 94116. June 1972. 19p. plus appendix.

23. LIFT INTERVIEW STUDY OF THE BOYNE COUNTRY SKIER. SKI Magazine, 380 Madison Avenue, New York, New York 10017. March 1976. 32p. plus appendix.

24. LIFT INTERVIEW STUDY OF THE HEAVENLY VALLEY SKIER. Robert L. Lundy. Tourism Research Associates, 2118 26th Avenue, San Francisco, California 94116. May 1978. 32p.

25. LOCATION ANALYSIS OF HIGH-VOLUME SKIING IN WESTERN UNITED STATES. Kenard E. Smith. The University of Minnesota. 1974. Thesis, Doctor of Philosophy. 204p.

26. MORE PEOPLE ON SKIS. American Ski Federation, 3 Dearborn Road, Peabody, Massachusetts 01960. 1975. 146p. $50.

27. 1970 VERMONT SKI AREA SURVEY. J. Robert Hill. Interagency Committee on Natural Resources, Montpelier, Vermont 05602. 1971. 96p.

28. THE 1977-78 STEAMBOAT SKIER SURVEY. Charles K. Mayfield, Steamboat LTV Recreation Development, Box 1178, Steamboat Springs, Colorado 80477. 1978. 88p.

29. NORTHEAST SKIER MARKET. State Planning Project, 34 Bridge Street, Concord, New Hampshire. November 1964. 48p.

30. THE OREGON SKI AREAS STUDY, 1967-1968 WINTER SEASON. Arthur Stonehill, Phillip Schary and James Noteboom. School of Business and Technology, Oregon State University, Corvallis, Oregon 97331. November 1969. 45p. $2.50.

31. PARTICIPATION AND CHOICE OF SKIERS IN CENTRAL NEW YORK: CHARACTERISTICS, SPATIAL PATTERNS AND PREFERENCES. John Hewett Munson. Syracuse University. 1974. M. A. Thesis. 112p.

32. PROJECTED CHANGES IN NORTHEASTERN SKIING PARTICIPATION AND SUPPLY CAPACITY AS INFLUENCED BY A CHANGING ECONOMY. Marvin Kottke. Storrs Agricultural Experiment Station, College of Agriculture and Natural Resources, University of Connecticut, Storrs, Connecticut 06268. October 1979. 40p.

33. SKI UTAH! A REPORT OF THE INDUSTRY. John D. Hunt and Christie Anderson. Institute for Outdoor Recreation and Tourism, Utah State University, Logan, Utah 84322. February 1976. 111p. $10.

34. SKIING IN THE GREAT LAKE STATES: THE INDUSTRY AND THE SKIER. William A. Leuschner. North Central Forest Experiment Station, Forest Service, U.S. Department of Agriculture, St. Paul, Minnesota 55101. 1970. 42p.

35. UTAH SKI MARKET STUDY, 1970-71. Center for Business and Economic Research, Brigham Young University, Provo, Utah 84601. September 1971. 60p.

36. VAIL PEAK DAY SURVEY. C. R. Goeldner and Jack Harrington. Business Research Division, University of Colorado, Boulder, Colorado 80309. August 1979. 130p. $25.

37. THE VAIL SKIER: 1977-78 SEASON. C. R. Goeldner. Business Research Division, University of Colorado, Boulder, Colorado 80309. 1978. 106p. $15.

38. THE WHITE BOOK OF SKI AREAS: U.S. AND CANADA. Robert G. Enzel and John R. Urciolo. Inter-Ski Services, Inc., P.O. Box 3635 Georgetown Station, Washington, D.C. 20007. 1978. 410p.

39. THE WINTER PARK SKIER, 1978-79 SEASON. C. R. Goeldner and Jack Harrington. Business Research Division, University of Colorado, Boulder, Colorado 80309. June 1979. 49p.

40. WINTER RECREATION VISITOR STUDY, WISCONSIN, 1979. Rollin B. Cooper, Sue Sadowske, and Mark D. Kantor. Recreation Resources Center, University of Wisconsin-Extension, 1815 University Avenue, Madison, Wisconsin 53706.

HUNTING AND FISHING TRENDS IN THE U.S.[1]

J. John Charbonneau and James R. Lyons [2]

Abstract.--Trends in hunting and fishing participation are evaluated on the basis of responses to a telephone survey of the U.S. population conducted as a part of the 1975 National Hunting and Fishing Survey. Probability of participation in hunting and fishing is a function of the respondent's age, sex, income, place of residence, and a number of supply characteristics. The availability of forested acres and total public recreation acres in a participant's state are also significantly related to the probability of hunting and fishing. The probability of non-participation is also evaluated. The impact of future changes in population parameters and pertinent supply characteristics upon hunting and fishing trends and the related policy implications are discussed.

Introduction

This paper will review hunting and fishing participation data to determine if any trends can be estimated and, to the extent possible, what causal factors influence these trends. In the traditional sense, a comprehensive analysis of hunting and fishing trends has not been undertaken. The scarcity of comparable time-series data is one probable cause for the paucity of trend analyses along with the small degree of success achieved by those who have tried. Another factor is that the underlying causal relationships which explain participation in hunting and fishing for the nation are just now being examined in a systematic way by Kellert at Yale in his study of American Attitudes Toward Animals. The fitting of a line through data points does not get the resource management information necessary for decision making. We must look beyond the trend line to the causal relationships and especially those that have some degree of public control. This research area, which calls for a multidisciplinary approach, will be where answers are found to help decision makers in the management of wildlife resources for the future benefit of society.

This paper is divided into three sections. First, a review of the existing data from past recreational surveys and state license data will be undertaken; second, an analysis of the data to determine causal relationships that could provide some insights into future trends; and third, an analysis of the causal variables with conclusions regarding the future participation rates of hunters and fishermen.

---

[1] Paper presented at the National Outdoor Recreation Trends Symposium, Durham NH, April 20-23, 1980.

[2] Economist and biologist,U.S. Fish and Wildlife Service, Washington, D.C.

Hunting and Fishing Participation Data

The most complete time series data on hunters and fishermen are the state license figures. Excluding saltwater anglers, these numbers are available on a state by state basis back to the year 1932. However, these figures are representative of all sportsmen who acquired a license to hunt or fish and do not include those categories of people who are exempt (e.g., for reason of age both young and old), those who hunt or fish on their own land, etc. Each of the 50 states has its own laws pertaining to exemptions from licenses. Figures 1 and 2 show the number of fishing and hunting license holders from 1955 to 1978. Projecting the number of license holders to the future would give us an estimate of participation rates but these figures would not include participation by the legally unlicensed group. The actual size of this latter group has not been estimated, but it most likely varies from state to state and may account for a considerable percent of partication in some parts of the country. For purposes of this paper, estimates of illegal hunting and fishing will not be included as it is unlikely it could be estimated from survey data.

A second source of statistics on hunters and fishermen comes from National Surveys. Since 1955 Hunting and Fishing surveys have been conducted by the Fish and Wildlife Service at 5 year intervals. Figure 3 shows the estimated total hunters and fishermen from 1955 to 1975. These figures represent participation by sportsmen 12 years of age and older. The upward trend evidenced by both hunting participation rates shows that increasing numbers of people are hunting and fishing. However, measured as a percent of population, the increased participation becomes a decreasing percentage of the U.S. population. This indicates that the relative popularity of fishing and hunting are declining. However, the relative popularity of any recreation is affected by changing preferences and trends in complementary activities and therefore may show up as some form of cyclical behavior over time. The difference between license holder trends and the national survey figures has not been completely reconciled. The National Surveys have not been designed in the past for direct comparability. License figures are a simple tally of sportsmen while the hunting and fishing survey estimates are based on population samples that are not restricted to that segment of the population that is required to have a license to hunt or fish. Therefore, it is expected that the survey estimates will be larger than the license figures. The expected magnitude of difference is unknown. Until such time as we fully understand what is being measured by the National Surveys there is a reluctance to predict the future with this data base. This conclusion holds for the other national surveys as well.

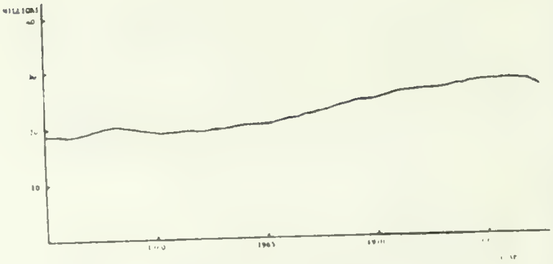


Figure 1.--Number of fishing license holders 1955-1978

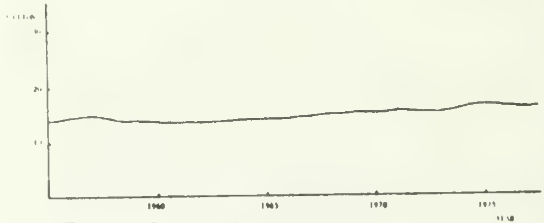


Figure 2.--Number of hunting license holders 1955-1978

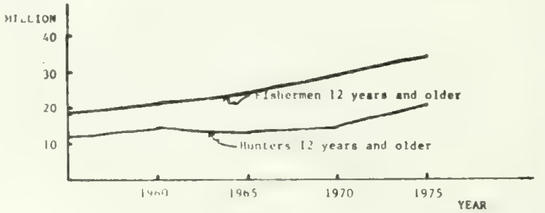


Figure 3.--Estimated number of fishermen and hunters in the U.S. 1955-1975

A third source of hunting and fishing participation data comes from a screening survey used in the 1975 National Survey of Hunting and Fishing. Using random digit dialing the population sampled was asked if they hunted or fished in 1975, and if they had not in 1975 they were asked if they had done so in 1972, 1973, or 1974. Table 1 presents the findings from a 10 percent sample of the screening questionnaire.

Table 1

A Comparison of Hunters and Fishermen who discontinued Hunting and Fishing in 1975

	Hunted in 1975	Hunted in 1972, 1973, or 1974 but not in 1975	Fished in 1975	Fished in 1972, 1973, or 1974 but not in 1975
Head of household	61.9	62.1	41.8	41.8
Spouse	9.4	20.6	20.0	27.5
Children	28.7	17.3	38.2	30.7

In order to analyze these data the probability of not participating was estimated for both hunting and fishing in 1975. Data from sportsmen who had participated in the years 1972, 1973, or 1974 but not in 1975 and those who had participated in 1975 were used to estimate the probability that sportsmen would discontinue hunting or fishing. The independent variables used in the equation consisted of social, demographic and measures of availability of opportunity in the state that sportsmen lived in. This equation was estimated with cross-section data using ordinary least squares regression. The equation, estimated for hunters and fisherment separtely, was:

$$\text{Non-Participants} = f(\underset{+}{\text{AGE}}, \underset{-}{\text{AGE}}, \underset{-}{\text{SEX}}, \underset{+}{\text{INCOME}},$$

$$\underset{+}{\text{METRO}}, \underset{+}{\text{HEAD}}, \underset{-}{\text{WATER}}, \underset{-}{\text{COAST}}, \underset{-}{\text{FOR}}, \underset{+}{\text{TREC}})$$

Where: Non-participants = 1 for those who did not go in 1975 but did go in 1972, 1973, or 1974.

Non-participants = 0 for those who went hunting (fishing) in 1975.

AGE - the respondents age
AGE^2 - the respondents age squared
SEX - the respondents sex, 0=female 1=male
INCOME - the respondents family income before taxes
METRO - 1 if the respondent lived in a metropolitan area 0 if the respondent lived in a non-metropolitan area
HEAD - 1 if the respondent is the head of the household and 0 otherwise
WATER - the square miles of surface water in the state
COAST - the coastal miles in the state of residence
FOR - the forested acres in the state, in millions
TREC - total acres of publicly-owned recreation land in the respondent's state, in thousands

The a priori expectation on the signs of the variables are given below the variables. The estimated coefficients are in table 2. The age of maximum probability of non-participation is 55 for fishermen. Without the age square term being significantly different from zero the age of maximum probability was not computed for hunters. Interpreted this means that with other factors held constant a fisherman's probability of discontinuing fishing decreases after age 55. The lack of a maximum probability for hunters is most likely due to a greater commitment that hunters included in the sample may have to their sport. Therefore, there was not a specific age group where most hunters were discontinuing hunting.

Table 2

Estimated Non-Participation Functions for Hunting and Fishing

	(1) Fishing	(t-value)	(2) Hunting	(t-value)
Intercept	.1980	(12.4)	.3538	(9.1)
AGE	.0035	(4.2)	.0042	(2.2)
AGE^2	-.00003	(3.1)	-.00002	(.8)
SEX	-.0999	(10.7)	-.2455	(12.2)
INCOME	$-.4\text{x}10^{-7}$	(.2)	$.3\text{x}10^{-7}$	(.1)
METRO	.0175	(2.3)	.0483	(3.8)
HEAD	.0079	(.7)	.0019	(.1)
WATER	$-.44\text{x}10^{-5}$	(1.2)		
COAST	$-.61\text{x}10^{-5}$	(.3)		
FOR	-.0014	(2.6)	-.0035	(4.6)
TREC			$.13\text{x}10^{-5}$	(1.9)
F-ratio	25.9		38.7	
$\bar{R}^2$	.0195		.0546	
N	11,738		5,373	

[illegible] maximum [illegible] 55

The probability of discontinuing fishing (equation (1) in table 2) indicates the influence of being male is negative and living in a metropolitan area is positive. Both of these findings are consistent with other research results. Income and being head of the household had no apparent influence on discontinuing participation. Looking at the influence of surface water availability it is not surprising that those states with more square miles of surface water have a lower probability of non-participation once a fisherman had been fishing in the past. The influence is not strong with a relatively high standard error but nevertheless it is present. The presence of forested acres also decreased the probability of non-participation. This is most likely due to the high correlation between forest acres and watersheds.

The influence of the social and demographic variables on the probability of non-participation in hunting (equation 2) was somewhat stronger than for fishing with approximately 5.5 percent of the variation explained. The influence of residence in a metropolitan area increased the probability of discontinuing hunting with other factors held constant. It can be interpreted that from a cross-section of hunters the probability of discontinuing hunting is increased if the sportman lives in a metropolitan area. A likely cause of this result is that hunting requires more travel time and cost for metropolitan residents than for non-metropolitan residents and therefore they may feel less committed to hunting as the costs rise over time.

As a measure of the availability of other outdoor recreation activities the variable TREC was included. Its positive coefficient indicates that hunters from states that have relative abundance of public recreation areas are more likely to discontinue hunting than hunters who live in areas where public recreation lands are less abundant. From the cross section of hunters in the sample it appears that income did not influence their decision about participation. It must be remembered that this data set contains only hunters and fishermen and the results only pertain to those who are already hunting or fishing and the factors that may influence their decision to continue in the future.

Looking to the future of participation in hunting and fishing activities the analysis shows that for fishermen the loss of currently available sites should increase the probability of non-participation. While the same is true for hunters, an increase in public recreation areas would further increase the probability of discontinuing hunting.

A Model for Determining Trends in Hunting and Fishing

The traditional models for extrapolating trend lines to the future do not capture the underlying relationships that cause trends to shift. Of particular interest are variables subject to policy manipulation by land management agencies. Specifically, it would be desirable to estimate the relationship between the availability of hunting and fishing opportunities and the probability of the general population becoming hunters or fishermen. To do a thorough analysis requires both cross-sectional and time series data on participants and non-participants, their social and demographic characteristics, the location of the hunting or fishing activity and a series of quantitative and qualitative variables describing both the sites used and others available nearby. Even though such a complete data base is not available to test hypotheses concerning determinants of fishing and hunting, this analysis will give insights into the practicality of pursuing this area of research.

The telephone screening survey used to determine participation for the 1975 National Survey of Hunting, Fishing and Wildlife Associated Recreation contains over 322,000 individual observations from 106,000 households. The screening questionnaire contains social and demographic characteristics of participants as well as non-participants in hunting and fishing. The sample includes approximately 2,000 households per state. A 10 percent sub-sample taken randomly from the telephone screening survey was used to test a limited set of hypotheses concerning the influence of policy variables on the probability that an individual would participate in hunting or fishing. Future projections of the significant variables in a probability equation will give an indication as to the expected direction of the trend for hunting and fishing.

The Model

It is hypothesized that the probability of an individual going hunting or fishing is associated with their social and demographic characteristics and the abundance of the areas where hunting and fishing take place in the individual's state of residence. A model for fishing and hunting is specified to account for the difference in hunting and fishing opportunities. Each equation is given below with the expected sign of the coefficients to be estimated.

$$\text{Fish} = f(\underset{+}{\text{AGE}}, \underset{-}{\text{AGE}}\ , \underset{+}{\text{SEX}}, \underset{+}{\text{INC}}, \underset{-}{\text{METRO}}, \underset{+}{\text{HEAD}}, \underset{+}{\text{WATER}}, \underset{+}{\text{COAST}}, \underset{+}{\text{FOR}})$$

$$\text{Hunt} = f(\underset{+}{\text{AGE}}, \underset{-}{\text{AGE}}\ , \underset{+}{\text{SEX}}, \underset{+}{\text{INC}}, \underset{-}{\text{METRO}}, \underset{+}{\text{HEAD}}, \underset{+}{\text{TREC}}, \underset{+}{\text{FOR}})$$

Where: Fish - the probability of going fishing in 1975, 1 for fishermen and 0 for non-fishermen

hunt - the probability of going hunting in 1975, 1 for hunters, and 0 for non-hunters

The factors influencing the decision to either hunt or fish may not be fully captured by this limited set of variables. However, those variable that have policy significance (i.e., surface water, forested acres, recreation acres) are of the most interest from a management viewpoint. Table 3 contains the results of the estimation of the hunting and fishing equations. The equations were estimated with ordinary least squares. The dichotomous dependent variable violates the assumption of homoskedasticity of the error term ordinary least squares but the large sample size makes the cost of estimating the equations with probit or logit extremely expensive. The large sample size will minimize the OLS bias and for practical purposes the coefficients are not significantly different between OLS and logit or probit. The findings of significance for the policy variables and the signs of the coefficients are of major interest at this stage in the analysis.

Table 3

The Probability of Fishing and Hunting in 1975

	(3) Fishing	(t-value)	(4) Hunting	(t-value)
Intercept	.098	(10.6)	-.067	(10.3)
AGE	.0089	(19.0)	.0087	(26.5)
AGE^2	-.00013	(23.2)	-.00012	(30.7)
SEX	.2204	(35.8)	.1886	(43.4)
INC	$-.29 \times 10^{-6}$	(2.2)	$-.14 \times 10^{-6}$	(1.5)
METRO	-.0479	(9.1)	-.0808	(21.8)
HEAD	.0155	(2.0)	.0758	(13.9)
WATER	.00003	(11.9)		
COAST	-.00012	(8.4)		
TREC			$.16 \times 10^{-5}$	(6.8)
FOR	.0014	(3.7)	.0015	(6.2)
F-ratio	325.6		720.5	
$\bar{R}^2$	.0888		.1609	
N	30,072		30,072	
Age of Maximum Probability	3			

The results in table 3 indicate that the probability of going fishing is at a maximum at age 33. That is, the probability increases until age 33 and then decreases as indicated by the negative sign on the age-squared variable. The probability is increased for males and for residents of non-metropolitan areas. Also, for those who indicated they were the head of the household the probability of being a fisherman increased. The results for hunting are the same as for fishing up to this point except the age of maximum probability is 35. Income had a negative sign for both hunters and fishermen. It appears that from a cross-section of respondents to the telephone interview the probability of going hunting or fishing decreased with increasing income levels.

The probability of fishing was positively related to the square miles of surface water in the respondents state and the quantity of forested acres. The forested acres variable was included as a proxy variable for other outdoor activities that may substitute for fishing. The positive sign on FOR indicates that states with a relative abundance of forest lands have an increased probability of fishing activity. The COAST variable was significant with a negative sign indicating that for this cross section of respondents those from states with considerable coastline had a lower probability of going fishing. All other variables held constant, the probability of a Rhode Island resident going fishing is higher than for a resident of Maine.

Interpreting the results for hunting, the expected positive sign for FOR was statistically significant indicating that increased forest acreage increased the probability of hunting activities. However, the sign on TREC is also positive indicating that an increase in public recreation acreage increases the probability of hunting. This result may be related to the fact that many areas are managed for multiple use and the increase in acreage for public use may also serve as wildlife habitat for game species thereby increasing the probability of hunting.

Future Participation in Hunting and Fishing

The participation rates estimated for 1975 were 31.6 percent of the U.S. population for fishing and 13.5 percent for hunting. An analysis of some of key variables used in the participation equation will give some insights to future participation rates. Even though precision is not possible at this time at least a determination can be made as to the direction of the trend for the future. The variables used for this determination are AGE, METRO, WATER, FOR, AND TREC.

AGE

The median age of the U.S. population is gradually increasing. After the post WWII baby boom the birth rate began to slow down in the U.S. With increases in life expectancy the median age of the population in 1975 increased to approximately 29 years. For each 1 percent increase in the median age of the population the probability of going fishing will increase by .865 percent and hunting by 1.99 percent.

METRO

In recent years there has been a shift in the population growth rates of the metropolitan and non-metropolitan areas. The metropolitan areas have grown at a rate of 3.4 percent from 1970 to 1974 while non-metropolitan areas grew 5.5 percent during the same time period. This is a reversal in trend from the 1960's to 1970's that is expected to continue to the 1980's. For each 1 percent increase in non-metropolitan area population the probability of going fishing will increase by .046 percent and .252 percent for hunting.

WATER

The square miles of surface water for most states varies only slightly over time. However, projects such as dams, canals, reservoirs, and man-made lakes are constantly being built. Most often such alterations of the landscape are a trade-off for running water at only a small net gain in surface acreage. For each 1 percent of net gain there is an increase in the probability of participation of .122 percent.

FOR

The trend in forested acreage across the country has been fairly constant for the past 10 years. Future demand for forest products may cause an increase in timber cutting. Increase in timber cutting and the shifting of private forest lands to other types of agricultural production may cause a decline in forested acres in the future. For each 1 percent loss of forest land the probability of going hunting will decrease by .117 percent. For fishing the probability will decrease by .047 percent.

TREC

The total acreage in publicly owned recreation lands which contains fish and game areas and natural wilderness that provide habitat for game species, is increasing over time. For each 1 percent increase in publicly owned recreation levels the probability of going hunting increases by .068 percent.

Summary

Over the next decade the U.S. population pyramid will show an increase in the number of U.S. residents in the age categories where participaution in hunting or fishing is a maximum. Also, the population growth of non-metropolitan areas is expected to continue, therefore there should be an increase in the number of U.S. residents that have the highest probability of going hunting or fishing. The factors that ultimately influence the actual participation are only partially captured by the changing availability of the activity in the individuals state of residence. Such factors as square miles of surface water, forested acerage and public recreation areas, which include fish and game areas and wildnerness areas, will contribute to increasing the participation in hunting and fishing in the future. However, the number of acres or miles of surface water, forests, or public recreation areas necessary to augment the current stock of these resources by 1 percent is not likely to have much impact on hunting or fishing over the next decade. The coefficients on these variables are trends only in an aggregate sense. However, if the specificity of these supply variables could be increased i.e., surface water of a specific type or quality and forested acres that are the habitats for specific game species, perhaps the coefficients would show a larger impact and affect trends for the future in a more discernable way.

The usefullness of adding policy variables that can be affected by resource management agencies has been shown to be a promising tool to aid in predicting the future of hunting and fishing activities. Further refinement of the model specified and more precise policy variables awaits the results of the 1980 National Survey of Fishing, Hunting, and Wildlife Associated Recreation. The use of 1980 Survey data will enable us to test the robustness of the model and any change over time in the structural parameters. This study is in the developmental stage and clearly more work needs to be done before reliable projections can be made.

OFF-ROAD VEHICLE TRENDS

Garrell E. Nicholes[1]

INTRODUCTION

Today I would like to start this part of my program by generally describing the vehicles, the users, and the current problems. Later on I will break out specifically motorcycles and snowmobiles to discuss. When I was asked, approximately a year ago, to fill this assignment, I began by telephoning those I knew in public and private ORV management positions. I sent letters and made many personal contacts as I traveled around the United States. As material arrived at my desk, I realized that "surface trends" research information, separate from "in house", was grossly lacking for this form of outdoor recreation. This paper is my attempt to verbalize the information we received. I warn you that what you hear me say may not be today's popular thoughts. With approximately 500,000 miles of travel in my off-road vehicle business responsibilities, I have realized that lack of valid quantity and quality trends information has been one factor contributing to current emotionalism, false concepts, and gross biases both for and against this activity. Another problem has been that there are many who profess understanding in planning for this reaction because they have some specialized knowledge that merely relates to the off-road vehicle. However, in fact, only a few public and private planners and land managers, academic types and others know and understand the vehicle, the land base and the enthusiast well enough to be credible problem solvers. Most problem-solving efforts have been crippled by confusion and misunderstanding from lack of good problem solution models. Special interest groups have resorted to political infighting.

Let me give you an example of current research information which, if pursued in more depth, could help solve some ORV problems we now face: Recreation, in and of itself, is a personal, multi-dimensional activity. It is done during one's leisure time and locates itself on a very broad continuum between the sharp contrast of furious involvement and contented relaxation. It may be backpacking, boating, horseback riding, tennis, exploring, camping or just eating, etc. As with each of these activities, motorized vehicle use is a dimensional extension of the individual that encompasses his physical performance. It rewards the participant for his skill and aptitude and he is further rewarded sociologically by his peers for his involvement. Lastly, he gains his own personal psychological growth as he reacts successfully to both positive and negative aspects of the experience.

I think we can sum up this very heavy, but important, concept by saying that recreation, and more specifically, off-road vehicle recreation, is different things to different people. It has to be researched, planned and provided for with this understanding.

Emotionalism and related problems we see today break down into three major areas: (1) a stereotyped image leading to unrealistic attitudes and actions towards the vehicle and its operator by the uninformed; (2) no standard base of definition, resulting in (3) poor inter/intracommunication. For us to discuss this phenomenon more effectively, we must achieve a common level of understanding.

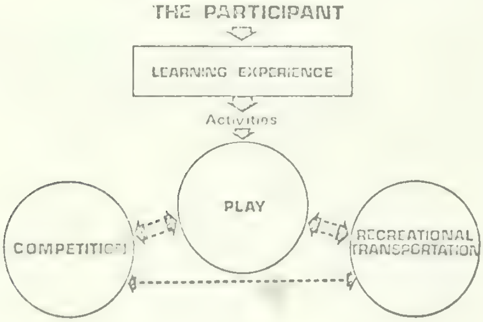
As previously mentioned, there are many kinds of "off-road vehicles" (ORVs): motorcycles, 4-wheel drive units, dune buggies, snowmobiles, etc. ORVs can be specifically designed for many uses, such as play activity, pseudo competition, structured competition, and recreational trail riding. The most common definition of ORV use implies only unstructured use of the equipment following no pathway on a resource. Knowledgeable viewers of the sport would expand the definition to acknowledge a substantial additional activity--that of using a lineal corridor, such as an unpaved, a graded or ungraded road, or a single wheel or similar pathway from Point A to Point B. (These definitions relate to both the design capabilities of the vehicle and how the enthusiast uses the machine.) The Statewide Planning Criteria chart will show relationships between machine and enthusiast for both definitions above. Who is the enthusiast? He is:

---

[1] Garrell E. Nicholes Associates, Incorporated, The People Planners, is a recreation planning and implementation consulting firm, which has worked with federal, state and local agencies of government, private industry and outdoor recreation enthusiasts. Mr. Nicholes' involvement with off-road vehicle equipment and its utilization spans over fifteen years involving most forms of recreation vehicles, e.g. 4-wheel drives, dune buggies, motorcycles and snowmobiles.

(1) One who is learning to operate the vehicle,
(2) One who is engaged in a play and/or unstructured competition experience allowing him to use the machine to produce the recreation in and of itself, or
(3) One who is involved in structured competition which enables him, after he masters the physical and mental requirements, to commit totally to the activity for a remunerative reward of some kind,
(4) One who uses the vehicle also as a tool of transportation to participate in other recreation activities, such as camping, picnicking, fishing, photography, cultural sightseeing, riding for pleasure, and many, many more opportunities.

STATEWIDE PLANNING CRITERA



As I travel around the United States, working with federal, state and local agencies on this phenomenon we call off-road vehicles, I sometimes wonder if the representatives of government bodies don't cringe just a little at the challenges these vehicles present to them. I am sure they are hoping that "change" will somehow alleviate the controversy between ORV users and non-users, and calm the political waves that seem to follow this activity.

Gerald Jacobs stated in his writing "Conflict in Outdoor Recreation" that:

> While theories of conflict are varied, many do share the perception of incompatibility as a common concept. In outdoor recreation, this concept suggests two factors at work: the perception of differences among people's lifestyles and the evaluation that encountering such differences is undesirable.

Positive adaption to change when some react in an unbiased manner to ORVs takes effort, not so much "reactive effort" as merely becoming informed. The "uninformed" often emotionally criticize ORV activity saying it creates high "impact" and seriously question it as a form of legitimate recreation. Even though alive and flourishing today, this thinking seems to be academic and after the fact.

In his April 14, 1971 press release announcing the establishment of an Interior Department Task Force to study the use of off-road recreation vehicles (ORRV), Secretary of the Interior Rogers C.B. Morton said: "We recognize that off-road recreational vehicle use is one of the many legitimate uses of federally-owned lands." To my knowledge, that philosophy has never been changed.

Stereotypes of ORVs have emerged over the years and persist in the minds of a large portion of the population. Reason is often overshadowed with statements that the vehicles "eat land"; "create environmental havoc"; "initiate devastating effects"; "disrupt animal life"; "impact moose"; "conflict with other human uses of the land", etc. The vehicles may, in some circumstances be what the above stereotypes depict them to be; however, more knowledgeable persons feel that such references could be eliminated with responsible research, planning, and facility implementation and management. Dr. Stephen McCool, in a talk before the forty-third North American Wildlife Conference, said, "ORV use appears to be more a function of intuitive managerial expertise and judgment and political pressure than a direct result of systematic problem-driven research."

John D. Peine, Ph.D., in an article entitled "Land Management for Recreational Use of Off-Road Vehicles, 1972," said:

> ORV owners are as diverse as their vehicle designs. Personal interest and use may influence land travel patterns and attitudes toward the landscape. To the performance-oriented vehicle owner, the vehicle may be an end in itself, with its mechanical development being its major recreational value. These attitudes are important to the land manager developing a plan to provide quality experiences for the various types of vehicle users. It appears doubtful that one management procedure would be adequate for all types of vehicle users.

Perhaps the definition of vehicles and user preferences should follow a multi-dimensional activity reasoning. Dr. Peine lists in priority activities popular among all off-roaders: hunting, seeing the countryside, challenging terrain, camping, fishing, exploring, picnicking, comparing performance, observing wildlife, taking photographs, etc.

Dr. McCool, in analyzing the 1977 national recreation survey, noted a few interesting facts about ORV users:

> "Despite years of research, we really know very little about the behavior and needs of ORVers.
> *ORVers tend to be much more recreationally active and diverse than non-ORVers.
> *ORVers view outdoor recreation as having greater importance than non-participants."

Dr. Keir Nash, in his research for the State of Washington, 1979, entitled "Understanding and Planning for ORV Recreation," summarized participant communication of problem perceptions of the activity this way:

> "An important feature of the off-road recreation policy debate is the frequency with which participants starting from different premises, talk past each other. Perceiving the problem quite differently, they interpret the relevant data differently."

Dr. Nash clarifies the communication breakdown between users and non-users this way:

> "The argument is advanced that underlying the conflict over ORV recreation are very different, occupation-related attitudes toward the machine. It is suggested that the real inconsistency lies not in mechanically-oriented-by-trade ORVers finding no disjunction between 'using machine' and 'appreciating nature', but rather in attitudes of verbally and visually oriented 'non-mechanicals' (professors, environmentalists, etc.) who think it all right for themselves to bring their 'tools in trade' into nature (books, scientific instruments, etc.) but not for the mechanically-oriented to perform the equivalent act. The duality between machine and nature is arguably created in the minds of the opponents--not a demonstrable 'real entity'."

In Summary of the Introduction

A vast amount of emotionalism and stereotyping of the sport exists due to a lack of knowledgeable people in planning and management for these vehicles. Basic definition information is lacking. The off-road vehicle enthusiast, by policy, is participating in a legitimate recreation activity. Past and current research has not provided information for adequate problem solutions. A communication breakdown exists among users, as well as between users and non-users. The ORV enthusiast is looking for social, physical, psychological recreational experiences, particularly "getting into nature". He is significantly more recreationally active in the out-of-doors than non-motorized participants, and because of his "mechanically-oriented-by-occupation attitudes", has difficulty communicating with or understanding non-machine-oriented resource recreators.

Government

Recently, while studying a number of state comprehensive outdoor recreation plans, I was able to put into words what the concerns of public policymakers and resource planners and managers were as they relate to off-road vehicles. Those thoughts about ORVs, generalized as simply as possible, are:

*The subject is controversial.
*ORV recreation legitimacy is still debated.
*Noise is a serious problem.
*ORV resource damage is evident.
*Illegal and unmanaged use is a major cause of damage to public and private lands.
*Planning to accommodate this recreation is necessary.
*A need exists for providing opportunities, but the enthusiasts' needs must be identified and evaluated.
*Few public agencies are providing opportunities, which encourages users to illegally trespass and operate their machines in unmanaged ways.
*Current environmental and social problems will be compounded by failing to provide for the needs of ORV enthusiasts.

Some other ORV concerns of state public officials are:

*Involvement of the federal government on public lands, as required by Executive Orders 11644 and 11989 continues to be a concern.
*Requests from special recreation interest groups for the recreation dollar to provide facilities and programs is outpacing the means to generate the funds.
*Questions of legitimacy of this activity arise as the availability and cost of recreation energy becomes a tradeoff with utilitarian and commerce activities.

Rogers C.B. Morton gave the legitimacy label to ORVs, but he also announced, in 1971, the establishment of an Interior Department task force to study the use of off-road recreation vehicles: "The need for planned action to reconcile the competing demands involved in the use of off-road vehicles is urgent." His charge to the task force was "to develop, in cooperation with the states and other federal agencies, conservation interests and the industry, a management plan to assure an optimum of recreation use with a minimum of environmental conflict." Unfortunately, nine years later, that charge for the most part is unmet.

As documented in the 1978 nationwide outdoor recreation plan, task force report Phase I...the San Joaquin County Council of Governments said:

> "It is obvious that off-road vehicles are not going to go away; therefore, there is a need for more areas where they can be appropriately used and conflicts minimized."

In recent years hundreds of laws, executive orders, and outspoken environmental groups and sympathizers have brought about increased restrictions and constrictions on ORV use of federal lands. This pressure is putting a further increased burden on states and local governments to solve existing problems. States have, for the most part, been ill-prepared or have not wished to respond with responsibility to this emotion-ridden recreation activity. Fourteen federal government agencies and offices currently "guide" and "regulate" ORVs in approximately twenty-four areas of concern. One Department of the Interior agency said of the legislative mandates: "In many instances these laws and directives are conflicting. Regulations to date to implement the laws have not been fully promulgated. Enforcement authority has yet to be effectively delegated."

Two more areas are of vital concern in shaping the future of ORV activity in the U.S.--the economy and energy.

Present economic moves by federal and state governments are shifting the burden of funding from these agencies to outdoor recreationists themselves. Dr. Douglas Sessoms, futurist and chairman, Recreation Administration, University of North Carolina, has said, concerning future recreation funding, "We must look for alternative sources of funding...a more diversified pattern of funding must be developed, e.g. taxes, grants, user fees, all of these will be required to sustain our efforts." Outdoor recreation enthusiasts themselves seem to concur with Dr. Sessoms, as a recent Michigan household study has borne out. To the question, "In general, do you think Michigan's public recreation should be paid for mainly through fees and charges, through general taxes, or both?", they responded with:

Fees and charges	50 percent/households
General taxes	13
Both	36
Other	1

Energy availability and future costs are another concern, not only of government suppliers, but of non-users who criticize motorized vehicle use on grounds that it may not be classed as a legitimate recreation.

Estimated motorized recreational fuel consumption from a recent Council of Environmental Quality (CEQ) "Off-Road Vehicles on Public Land" report can possibly put in perspective the energy question.

Snowmobiles:
53 gallons per year per vehicle
2.2 million snowmobiles
Fuel consumption = 116.6 million gallons

Motorcycles:
30 gallons per year per vehicle
(1,500 miles per year divided by 50 miles per gallon)
5.4 million ORV cycles
Fuel consumption = 162 million gallons

Dune Buggies:
33 gallons per year per vehicle
(500 miles per year divided by 15 miles per gallon)
250,000 dune buggies
Fuel consumption = 8.25 million gallons

Four-Wheel Drive Vehicles:
500 gallons per year per vehicle
(5,000 miles per year divided by 10 miles per gallon)
1.5 million 4x4s used off-road (very rough estimate)
Fuel consumption = 750 million gallons

Subtotal	1,036.85
& other ORVs	13.15
Total	1,040 million gallons

I think Mr. Russ Shay's comment as editor in the July Sierra Club ORV Monitor editorial on this subject best sets a perspective as the situation is today: "Is that less than one percent (of gasoline consumed by all off-road vehicles) a terrible waste? People who say YES usually yield to a prejudicial judgment that ORVs are non-productive and, therefore, non-essential, and eminently expendable...But, once you start advocating "fuel censorship" by government, watch out. It's a Pandora's box..."

The high interest in outdoor recreation of ORVs over non-motorized participants suggests, as does the McCool analysis of the nationwide survey, that motorized vehicle participants will take "shorter trips for outdoor recreation... and it is likely to lead to higher frequencies of conflict with other recreational experiences and land uses."

In a 1979 Utah State University Department of Forestry study of 1500 randomly-selected households in six major metropolitan centers...a large majority agreed they would take less frequent trips (79.2 percent) and select vacation locations closer to home (76.6 percent) if energy became scarcer.

Enthusiasts' Problems and Needs

While government, environmentalists, and the public stereotype users into increasing restricted programs, the ORVers generally identify their problems and needs to be these:

*Federal, state, county or community governments are developing no visible ORV programs or facilities.
*Existing facilities and programs are poorly maintained and crowded.
*Former riding areas have been closed with no new alternatives being provided.
*Public agency ORV policies are either inconsistent or nonexistent.
*Few trained ORV administrators currently implement and operate facilities or programs.
*Major communication gaps exist between ORVers and federal and local land planning and management agencies.
*Few educational programs are in existence to objectively teach users, non-users, legislators, administrators, land planners and managers about ORVs.
*Non-participants inaccurately perceive ORV impacts; users believe those perceptions are more emotional than reasonable.

The Motorcycle

Let's focus on one of these vehicles, the motorcycle, and make some observations. There are 7,305,000 motorcycles in the U.S. today. You may appreciate that approximately fifty percent of the cycles sold each year are road bikes, and the other fifty percent, or 3,978,400 are off-road bikes. On-road and off-road motorcyclists annually generate approximately $6.1 billion in consumer sales and services, state taxes and licensing. In 1978, an estimated 4.7 million off-road capable motorcycles were used by 11.7 million people, which generated over $3 billion in consumer sales and services, state taxes and licensing. Last year the sales of off-road bikes to Americans exceeded 600,000 units.

Off-road motorcycles accumulated 50 percent of the 4.3 billion miles traveled last year by off-road/off-highway cyclists combined. Off-highway dual purpose cycles accounted for 27 percent of the mileage, and on-highway cycles accounted for 23 percent of the mileage. The number of cycles (on-road and off-road) retired each year (est. 1978) is 1.7 million. To put in perspective the 4.3 billion miles traveled by off-road, dual-purpose, and on-road bikes, all motorized vehicles in 1978 traveled an estimated 1,504 billion miles.

Motorcycle sales are increasing in response to the current energy crisis. Total sales through August 1979 look like this: under 125cc up 133.8 percent; 125 to 349cc, up 30.3 percent; 350 to 449cc, up 48.8 percent. The Motorcycle Industry Council says:

> "The up-demand for motorcycles is due in part to some families buying a cycle for short shopping trips, etc., instead of buying a second car. Fuel cost is a major factor...cycles can get 80-90 miles per gallon, an important consideration."

Total sales this year are expected to increase about ten percent. Utilitarian and recreational use of the motorcycle will likely continue to promote increased consumer acceptance as the present economy and energy situation lasts.

According to the 1977 National Recreation Survey, among those who engaged in recreation activities more than four times during the past twelve months, "driving vehicles or motorcycles off road" was more popular than:
*Hunting,
*Camping in developed or primitive areas,
*Ice skating outdoors,
*Canoeing, kayaking, or river running, or
*Cross-country skiing, and was as popular as
*Boating

Cycle Magazine's 1977 subscriber survey indicated that their readers during the last twelve months personally participated in:

*Camping	49.6 percent
*Fishing	49.6
*Hunting	40.4
*Boating	39.3
*Bicycling	38.2

Demographics

The ORV user is typically a married male, average age of 29.8 years who has attended some college, and is in a craftsman or foreman position. His average income is $18,928. Seventy-seven percent have previously owned a motorcycle; 23 percent of current owners have never owned one before.

Dr. Keir Nash, whom we have previously quoted, says:

> "Underneath a surface of similar average education, income, family lifestyle, there appear to be important differences--

> especially in regard to the percentages of college-educated ORV recreationists (low, and not increasing substantially over the generations) and to the percentages of those in skilled craftsman and manual labor occupations (high, as is also union membership). There are disproportionately few high-status professionals among the ORV recreationists, except for engineers."

Recent happenings in motorized vehicle sales have brought much speculation about future direction public agencies should take in research, planning, and management. Private industry is also looking closely at future market opportunities and problems that may arise from the economy, energy, federal and state laws and regulations.

Off-Road and Dual-Purpose Motorcycles According to the Motorcycle Industry

The off-road motorcycle, as well as the dual-purpose machine, has suffered from the new emphasis on the utility aspects, rather than the recreational aspects, of motorcycling. The off-road cycle decreased 4.3 percent in unit volume during the first half of 1979.

(and)

Dave Sanderson, Executive Director of the New England Trail Riders Association, says, "We are viewing the backside of a fad. We are seeing the maturation of a recreation activity and are witnessing a plateau of new enthusiasts."

Sanderson continued, "Unlike snowmobiling, whose users are concentrated in rural areas, motorcyclists in the northeastern United States are located in urban environments." He said, "I foresee that users will seek more recreational trail riding activity than play areas in the future."

Snowmobiles:

Snowmobiling has erupted from an insignificant activity in the early sixties, engaged in by enthusiasts mostly within the upper snowbelt states, to one of the most popular winter outdoor recreation activities today.

Currently, 1,900,000 (est.) snowmobiles are in use in the United States with approximately 14,200,000 snowmobilers participating in the sport. Snowmobiling and directly-related economic activity has reached over 1.6 billion dollars annually and generates in direct state tax and registration fee receipts $77.6 million dollars a year.

The present market appears to be basically a replacement one; approximately 85 percent of all snowmobiles are sold to those who already own at least one machine. This information is verified by A.C. Nielsen Research as interpreted by SnowGoer Magazine, which states, "The new buyer will likely come from present snowmobilers who do not own snowmobiles at the present time."

The past two sales years for snowmobiles have been most successful. The apparent reasons for two growth years back-to-back have been good snow conditions, a positive and growing economy, good positive dealer optimism, new areas of snowmobile use opportunities, and exceptional positive media coverage.

A November 9, 1979 Kiplinger Report states that "snowmobile sales are slumping...will be off ten to fifteen percent this season. Recession talk scares some buyers." Current government, industry, and users' comments followed: currently snow conditions are poor, a questionable economy, possible scarce energy availability, increased machine prices, and fewer available places to go. All these negatives are forging early unrest in the consumer's mind for purchasing snowmobiles in the 1979-1980 year.

Jerry Bassett, editor of SnowGoer Magazine states:

> "The manufacturers that I've talked to think that recession, rather than fuel, will be the biggest determining factor to snowmobile sales, usage, etc. Overall, the industry outlook seems extremely optimistic in light of everything. Manufacturing levels are virtually in a 'sold-out' situation. This, of course, is a reflection of building to dealer orders--plus a percentage of increase."

Demographics

The typical snowmobiler is married and has 2.8 children over ten years of age. His average age is between 25 and 49 years. He is a skilled, blue collar worker, whose family income averages between $15,000 and $20,000 per year. More than eight out of ten live in what would be considered rural areas. He lives where he can use his equipment on or directly from his homesite.

A study conducted by the Montana Department of Fish, Game and Parks shows that snowmobilers have a higher rate of participation in many other outdoor winter recreation activities than does the average Montanan. Of the 140,000 snowmobilers in Montana, one out of five also participates in downhill skiing, one out of seven in

Nordic skiing, one out of ten in snowshoeing, and more than one out of three in ice fishing. Almost half also participate in winter wildlife observation; approximately one out of five enjoys winter wildlife photography.

Snowmobile acceptance on public lands continues to increase, as depicted in a recently released national park policy statement:

> "Snowmobiles are viewed as a mode of transportation which provide an alternate form of access when snow cover interrupts normal vehicular access to a park. Snowmobiles can transport park users to and from areas which are set aside for non-motorized forms of winter recreation, such as ice fishing, snowshoeing and cross-country skiing."

Not only is this acceptance increasing with resource administrators, but with that positive image growth, enthusiast solidarity has grown through their active involvement in moving legislation and political action; they have sought improvement of the sport through making money available, park development, and most recently, private industry initiative to establish destination tourism opportunities.

Trends

Now that we have dissected a number of elements that make up the off-road motorcycle experience, let's piece back together what that information may be telling us. In other words, let's look at how we might perceive motorized vehicle trends.

*The future of the off-road experience will depend on availability of land for specific ORV activities, the severity of regulations, and the capability of enforcement of federal laws dealing with the environment, resource conflicts, and consumer protection.

*Because of diminishing energy availability and its increasing cost, ORV activities will soon move closer to the enthusiasts' residences, specifically in urban population areas.

*Federal land management agencies will gain greater control over regulation ORV use on public lands; they will support increasingly fewer off-road recreation opportunities and provide less financial support in land acquisitions and programs. This leaves states, local communities, and enthusiasts responsible for increased acquisition, planning, and managing of these facilities.

*As demand for facilities and services grows because of increased efforts by special interest groups of the recreating public, so will conflicts between motorized and non-motorized recreation activities. Better planning and management by state and local government to meet these demands will be needed. Those activities that financially support their needs will enjoy the rewards of their efforts. Those who don't contribute financially to their sport will be looking for places to participate.

*As public officials, enthusiasts, and non-enthusiasts are exposed to credible ORV people, information, and programs, adequate facilities will be identified, planned and developed. This will enable planners and managers to accommodate ORVs without environmental and user conflicts taking place.

*Motorcycle enthusiasts in the future will consider this equipment more seriously as transportation alternatives to the automobile; therefore, we will see increased purchase consideration of on-road bikes and dual-purpose motorcycles.

*Over the next decade we can expect to see shrinking of organized and semi-professional competition events, while those participating in recreational trail activities close to home will increasingly enjoy the out-of-doors in various forms.

*Unmanaged off-road play experiences on public lands will be increasingly constricted.

*Despite years of ORV research, lawmakers, resource planners and managers, and enforcement agencies know very little about the behavior, needs, and trends of this recreation group. During the first half of the 80's, researchers will be necessary by increased litigations over user and resource conflicts to take a more scientific approach to representing all outdoor recreators, as well as doing a better job in planning and managing public recreation lands for this activity.

Summary Brief

Stephen F. McCool seems to summarize what I want to say:

> "Despite years and years of research, we really know very little about the behavior and needs of snowmobilers and off-road recreation vehicle (ORV) users."

We won't solve the existing problems until we know who the motorized vehicle user is and what he wants from his sport.

LITERATURE CITED

Alexander, Steven J., and Gale C. Samsen. 1977. Off-road vehicles, gasoline consumption and patterns of use. Mich. Dep. Nat. Res.

American Motorcyclist Association. 1978. Facts about trail riders. Ohio.

Bury, Richard L., Stephen McCool, and Robert C. Wendling. 1976. Off-road recreation vehicles. A research summary 1969-1975. Texas A & M.

Continuing Market Analysis of Snowmobile Owners. 1979. A profile of snowmobile households in the United States. Snowgoer, Minn.

Council on Environmental Quality. 1978. Off-road vehicles on public land. U.S. Gov. Print. Off., Washington, D.C.

Jacobs, Gerald. 1979. Conflict in outdoor recreation--the search for understanding. Utah Tourism and Rec. Review, Vol. 6, No. 4.

Kiplinger Report. 1979. Ski sales will be strong this year...but snowmobile sales are slumping. The Kiplinger Washington Letter, Vol. 56, No. 45, Washington, D.C.

McCool, Stephen F. Impacts of ORVs: Snowmobiles, animals and man. 43rd No. Amer. Wildlife Conf.

McCool, Stephen F. 1978. Snowmobilers, off-road recreation vehicle users and the 1977 National Recreation Survey. Sch. For., U. Mont.

Michigan Snowmobile Use Survey. 1976. Department of Natural Resources, Law Enforcement Division, Mich.

Morton, Rogers C.B. 1971. ORRV off-road recreation vehicles. Taskforce Study, Dep. of the Int., U.S. Gov. Print. Off., Washington, D.C.

1979 Motorcycle Statistical Annual. 1979. Motorcycle Industry Council, Cal.

Nash, A.E. Keir. 1979. Understanding and planning for ORV recreation. The 1978-1979 Washington Off-Road Rec. Survey, IAC, Washington, D.C.

1977 National Outdoor Recreation Survey. 1977. Opinion Research Corporation for HCRS 1977, New Jersey.

The 1978 Nationwide Outdoor Recreation Plan. 1978. Taskforce Report Phase #7, issue compendium. U.S. Dep. Int. HCRS.

Peine, John D., Ph.D. 1972. Land management for recreational use of off-road vehicles. Tuscon, Arizona study paper submitted to the U. Ariz., Dep. of Waterched.

Public Preference for Financing Public Recreation. 1977. Recreation Planning Report #3, Mich. Dep. Nat. Res., Lansing Mich.

Shay, Russ. 1979. From the back of the gas line. The ORV Monitor, Vol. IV, No. 3.

Sessoms, H. Douglas. 1979. The future of recreation and parks. Parks and Recreation Magazine, Washington, D.C.

Utah Tourism and Recreation. Gasoline prices and availability: What do they mean for tourism? Utah Tourism and Recreation Review, Vol. 8, No. 3.

NATIONAL BOATING TRENDS[1]

Albert J. Marmo[2]

Abstract.--This paper examines the characteristics of recreational boats and boaters in the United States and the nature and extent of boating activities. The primary sources of the information presented are the United States Coast Guard's Nationwide Boating Surveys conducted in 1973 and 1976. The evidence indicates that boating is a major form of outdoor recreation with a broad base of participation which has experienced continuous growth.

INTRODUCTION

We do not know when the first boat was uilt. We do know that primitive men made ugout boats and canoes from large logs. he North American Indians built birchbark anoes, and the Eskimos built kayaks using eal skins. In other parts of the world, icker and reed boats were common. While hese early boats were built for work, they erved as models for the "pleasure" or recreational" craft that began to appear undreds of years later.

Nobody really knows when recreational oating began. Little was recorded about t until the mid-1600's, when Charles II ntroduced yachting into England, according o the World Book Encyclopedia. The first nglish yacht club was founded in 1775. In he United States, recreational boating egan in the early 1800's. The first acht club was organized in New York City n 1844. In the early 1900's it is estimated that there were not more than 100,000 ecreational boats in the entire United tates.

The growth in boating hit its peak tride immediately after World War II. Boating industry estimates reveal that there were approximately 2.4 million recreational boats in use in the United States in 1947. This number had doubled little more than five years later. There were various reasons for the rapid growth. As in other areas after World War II, technological advances in materials and building/assembly techniques permitted mass production of lightweight boats, and therefore brought down the cost of owning a boat. Improvement of the outboard motor, and new inventions such as electric starters made boat operation easier for many people, including women. Boat trailers were introduced for use with the fast growing automobile fleet. Boat financing and insurance were facilitated. Additionally, a wider variety of boats became available to meet buyer demands, and a market opened up for used boats, contributing to the perpetuation of this dynamic process. The population of the nation continued to increase, as did its mobility. Personal income was rising and lifestyles becoming more active. With longer vacations and more holidays, about one-third of the year became available to the average worker for leisure. Boating retail expenditures were estimated to be 1.23 billion dollars in 1955 for boats and equipment, fuel, insurance, maintenance and repairs, storage, docking, launching and club membership. These expenditures increased to $2.68 billion in 1965, $4.8 billion in 1975, and $7.5 billion in 1979 (MAREX 1979). There are currently over 2,600 boat manufacturers in the United States producing a myriad of boats, and about 6,000 marinas, boat yards and yacht clubs providing essential waterfront services.

---

[1] Paper presented at the National Outdoor Recreation Trends Symposium, Durham NH, April 20-23, 1980.

[2] Chief, Policy Planning and Information Analysis Staff, Office of Boating Safety, U. S. Coast Guard, Washington, D.C.

THE COAST GUARD'S RECREATIONAL BOATING SAFETY ROLE

Recreational Boating Safety Program

The United States Coast Guard's early involvement with recreational boating was primarily search and rescue after a mishap occurred. There was some involvement, however, in the preventive aspects of boating safety. Two Federal laws, passed in 1910 and 1918, dealt with motorboat regulation. The Coast Guard's role grew as boating grew. The Motorboat Act of 1940, which superseded the 1910 Act, expanded Coast Guard authority to regulate safety equipment such as life preservers and fire extinguishers on motorboats, also, it provided for penalties for reckless or negligent motorboat operation. The Federal Boating Act of 1958 provided for Federal and State cooperation in the interest of uniform boating laws and enforcement, making the states partners with the Federal Government in regulating recreational boating.

The Coast Guard was moved organizationally from the U. S. Treasury Department to the Department of Transportation in April 1967. There was growing recognition that boating was becoming a more diverse, complex and dynamic recreational activity. Congressional interest was running high. In his 1968 message to Congress on the American Consumer, President Johnson spoke to desired improvements in the area of recreational boating. All of this interest and review of boating safety led to passage of the Federal Boat Safety Act of 1971. This Act was intended by Congress to provide, in one statute, a comprehensive national program having three main objectives: cooperative Federal/State programs, improved boat design and construction, and, more flexible regulation of boat operators. This is the present basic authority for the Coast Guard's Recreational Boating Safety Program. The objective of the program is to reduce the risk of loss of life, personal injury and property damage associated with the use of recreational boats to provide boaters maximum safe use of the nation's waters. The program is broad-based, having direct impact on the states, manufacturers of boats and associated equipment, dealers, distributors, importers and the boating public.

The Need for Data

As the Recreational Boating Safety Program responsibilities grew and became more complex, the need for data for the Coast Guard to manage the program grew. The Coast Guard had been assigned the responsibility for promulgating regulations dealing with manufacturer requirements for safe boat construction. In order to determine where safety problems existed, more had to be known about the boat population. The Coast Guard had been collecting and publishing boating accident statistics since passage of the Federal Boating Act of 1958. Rates, not raw accident data, however, are needed to identify the relative magnitude of safety problems and to determine effectiveness of safety programs. The Coast Guard reports annually on the number of boats registered by the states. The registration or numbering data has limitations. Initially, only boats over ten horsepower had to be registered. Presently, all motorboats are registered. Although some states go beyond this, the large nonpowered fleet is essentially not covered in this system.

Education and enforcement are two other major elements of boating safety programs. Knowledge about the number, characteristics and activities of boaters is necessary to most effectively carry out these program responsibilities. The boat operator is the primary target of safety efforts.

Boating Surveys

A Coast Guard sponsored survey was conducted in the Fifth Coast Guard District (Maryland, North Carolina, Virginia and the District of Columbia) in 1969 to determine the feasibility of collecting boating information from the general public. The regional survey proved successful, and the telephone methodology utilized was later expanded to nationwide scope. Based on cost and time considerations and the capability for immediate interaction between interviewer and respondent, the telephone survey was chosen over personal interviews and mail survey mediums. The Coast Guard has sponsored two comprehensive surveys of the boating public. They were conducted during the months of April and May 1974 and covered 1973 boating activities, and April, May and June 1977 and covered 1976 boating activities. A stratified sampling plan was employed in the surveys. The Continental United States was partitioned into 400 geographical strata consisting of one or more counties. Two telephone central offices were selected at random for each stratum, resulting in 800 Primary Sampling Units. Within each central office, the final four digits of each telephone number to be dialed were then randomly selected by computer. For the 1976 survey, 28,261 households were contacted by a contractor. Of these, 6,018 were boating households, that is, one in which someone owned and/or operated one or more boats in 1976. There were 5,507 completed interviews of boating households.

The survey reports are compilations of answers by individuals, weighted at the completion of the interviewing period to give national estimates. These surveys were relatively modest attempts to gain some of the data required to carry out program responsibilities. We learn from each iteration and build upon this knowledge. The surveys have provided many valuable indications of the actual situation. While the Coast Guard surveys represent the most comprehensive national boating surveys known, there are other boating data developed principally by the boating industry, States and other Federal agencies. All provide valuable insights in the areas they were intended to address. This paper highlights much of the varied data on boats, boaters, and boating activities contained in the Coast Guard surveys. Unless otherwise noted, reference to "the survey" or "surveys" throughout the paper will mean the Coast Guard Nationwide Boating Surveys.

BOATING HOUSEHOLDS

Boat Operators per Household

The Coast Guard surveys looked at boating households. A boating household is defined as one in which at least one member actually operated a boat in the survey year. The surveys identified 10.6 million boating households in 1973 and 14.9 million in 1976. One out of every five households in the United States in 1976 had at least one boat operator. Table 1 shows numbers of operators per household. The share of households with only one operator decreased by about 10%. Households with two operators increased about 5%, and those with three or more operators increased by lesser amounts. This attests to a greater active family involvement in boating.

Table 1.--Boat operators per household (USCG 1978)

Operators per household	Year	Number of boating households	Percent of operator households
1	1973	5,529,000	52.1
	1976	6,373,000	42.8
2	1973	2,985,000	28.1
	1976	4,965,000	33.3
3	1973	1,114,000	10.6
	1976	1,800,000	12.1
4	1973	[illegible]	5.3
	1976	1,010,000	6.8
5	1973	258,000	2.4
	1976	409,000	2.7
6	1973	116,000	1.1
	1976	233,000	1.6
7 or more	1973	43,000	0.4
	1976	105,000	0.7
Total	1973	10,613,000	100.0
	1976	14,895,000	100.0

Boat Ownership

There were 7.3 million households in 1973 and 9.6 million in 1976 in which one or more recreational boats were owned. The latter survey indicated that the average number of boats per boat-owning household was 1.31, and 21.1% of boat owning households owned more than one boat. Table 2 shows the number of boats owned per household.

Table 2.--Household boat ownership (USCG 1978)

Number of boats owned	Year	Number of households	Percent of boat owning households	Percent change
1	1973	[illegible]	80.6	
	1976	7,559,000	78.9	28.2
2	1973	991,000	13.6	
	1976	1,377,000	14.4	38.9
3	1973	260,000	3.6	
	1976	390,000	4.1	50.0
4 or more	1973	165,000	[illegible]	
	1976	258,000	2.7	56.4

There is almost an even division in the way owners obtained their boats in 1976. According to the survey, approximately 48% bought their boats new, and a nearly equal number bought used boats. The remaining 4% built their own boats, some from kits.

Owners of 64.5% of new boats indicated that they had no intention of selling their boats, 5.5% had already sold the boat they used in 1976; the remaining boats were going to be kept anywhere from one month to more than five years. About 18% of the households that operated a boat in 1973, and 25% in 1976, rented a boat one or more times. In 1976, 9.2% of these households rented only one time, 5.3% twice, 5.6% three to five times, and 5.0% more than five times.

A national study of consumer attitudes toward recreational boating sponsored by the boating industry indicated that the median family size of boat owning household was 3.7 members (MAREX 1979).

Participation in Boating Activities

A major finding of the Outdoor Recreation Resources Review Commission's report to the President was that, "Water is a focal point of outdoor recreation - most people seeking outdoor recreation want water - to sit by, to swim and to fish in, to ski across, to dive under, and to run their boats over" (ORRRC 1962). Boating provides a platform for these and other water activities.

Members of boating households participated in one or more of a variety of boating activities. The basic proportions were similar between 1973 and 1976. The percent of households participating in water skiing showed the biggest increase, about 8%. Canoeing and whitewater activities were not separately broken out in the 1973 survey. Table 3 shows the households participating and the percent of time spent in the various boating activities in 1976.

Table 3.--Household participation in boating activities in 1976 (USCG 1978)

Activity	Households participating	Percent of households[a]	Percent of time spent
Pleasure cruising or sailing	9,312,000	62.5	31.5
Water skiing	5,617,000	37.7	13.7
Recreational fishing	11,422,000	76.7	44.7
Hunting	1,023,000	6.9	1.6
Racing	712,000	4.8	1.3
Commercial use - incl. fishing	391,000	2.6	.8
Whitewater canoeing	1,044,000	7.0	1.2
Other canoeing	2,359,000	15.8	4.6
Whitewater rafting	401,000	2.7	.3
Whitewater kayaking	161,000	1.1	.1
Other kayaking	289,000	1.9	.2
			100.0

[a] More than one response is possible for each of the 14,895,000 boating households.

It is clear from the survey that boating households are also active in recreational activities other than boating, including camping, fishing, hunting, athletic sports, and other outdoor recreation. Ninety-eight and one-half percent of boating operator households participated in one or more of these activities; 24% were active in all five. Recreational fishing had the highest percentage of participants, 88.4%.

BOATS

Number of Boats

The Coast Guard has been collecting data on numbered or registered boats since the passage of the Federal Boating Act of 1958. Only motorboats of 10 or more horsepower had to be numbered. Some states expanded boat numbering requirements in the intervening years. The Federal Boat Safety Act of 1971 required all motorboats to be registered. Some states have gone beyond this and register all watercraft. While the numbering data has limitations for trend analysis due to some variances in state numbering requirements, it does provide long term data regarding the basic composition of the motorboat fleet. A major thrust of the Nationwide Boating Survey was to provide data on the non-powered boats as well as powerboats. Over 8.1 million boats were numbered in 1978. The total number of all boats according to the 1976 survey was 12.75 million. The number of boats in the United States more than doubled in twenty years.

Characteristics of the Boat Population

Boats are generally characterized by a variety of factors, including type, length, hull material, engine type and horsepower.

Boat types. There are many terms used to identify boat type. Broad categories include open motorboats, cabin motorboats, rowboats, sailboats, inboard boats and outboard boats, for example. More specific classes include runabouts, cruisers, johnboats, and many others. A long list of specific boat types was used in the 1976 survey. Some people had problems placing their boats within the types. Many people simply refer to their small boat as a "fishing boat". Six major groupings of boat types are used in this paper. It is felt that these are most representative of the many boat types, and will be easily identifiable in the mind of the reader. There is no question that the small open boats, powered and nonpowered, comprise the lion's share of the boating fleet, about three-fourths.

The relative percentage share of each major grouping of boat types is as follows:

Rowboat, Johnboat, Skiff and other open, undecked lightweight boats	42%
Open Runabouts (decked and powered)	31%

Sailboats (powered and nonpowered)	9%
Canoes and Kayaks	9%
Cabin Cruisers and Houseboats	5%
Inflatables, Rafts and Thrill Craft	4%

Boat length. The simplest and most direct measure of boat size is length. Classification of motorboats by length is established by Coast Guard regulations. These classes, set by the Motorboat Act of 1940, are:

Class A	Less than 16'
Class 1	16 to less than 26'
Class 2	26 to less than 40'
Class 3	40 to not more than 65'

Pleasure boats over 65' are documented by the Coast Guard. Numbered boat data provides a wealth of trend information regarding motorboat length. According to the 1978 data, 62% of the numbered motorboats are less than 16', 97% are less than 26' (USCG 1979). Table 4 shows the percent of boats by length class for the past ten years.

Table 4.--Motorboat length (USCG 1969-1978)

Length class	Percent by year						
	1978	1977	1976	1975	1973	1971	1969
Class A	62.22	63.68	64.31	65.58	65.20	64.53	66.28
Class 1	34.66	33.33	32.67	31.46	31.44	31.91	29.99
Class 2	2.76	2.66	2.69	2.65	3.03	3.19	3.37
Class 3	.36	.33	.33	.31	.33	.37	.36

The 1976 survey showed that 55% of all boats, powered and nonpowered, were under 16', and 96% under 26'. The 1973 survey contained similar findings. The following percentage share of boat type by length were computed by excluding the other or unspecified types reported in the 1976 survey. The rowboats, johnboats, skiffs, dinghys and other open lightweight boats accounted for 61.4% of boats under 16', sailboats 8.3%, canoes and kayaks 7.5% and open runabouts 19.9%. The open runabouts also accounted for 49% of boats between 16 and 25', open lightweight boats 18%, canoes and kayaks 12.7%, cabin cruisers and houseboats 8% and sailboats 7.2%. There were 418,000 boats between 26 and 39', consisting primarily of cabin cruisers, sailboats and houseboats. These types also account for most of the 78,000 boats over 40' in length.

Hull material. That material which constitutes the majority of the shell of the vessel is its hull construction. One of the clearest trends available is hull material preference. From the ten-year boat numbering data reflected in Table 5 it can readily be seen that fiberglass has become the predominant hull material, replacing wood. Aluminum has pretty much held its own.

Table 5.--Hull material (USCG 1969-1978)

Year	Hull material				
	Wood	Fiberglass	Aluminum	Steel	Other
1978	10.91%	47.28%	36.80%	1.43%	3.58%
1977	12.10%	45.66%	37.90%	1.47%	2.87%
1976	13.48%	44.54%	36.90%	1.47%	3.61%
1975	14.24%	43.07%	37.05%	1.68%	3.96%
1974	16.62%	41.48%	35.70%	2.32%	3.88%
1973	18.66%	40.75%	34.58%	2.10%	3.91%
1972	23.08%	38.37%	33.03%	2.26%	3.26%
1971	25.67%	37.06%	31.64%	2.20%	3.43%
1970	29.04%	35.29%	30.27%	2.39%	3.01%
1969	31.38%	33.41%	29.30%	2.45%	3.46%

Fiberglass overtook wood as the most used hull material in 1969. New, more exotic and efficient hull shapes made fiberglass' advantage of molding-ease attractive. Fiberglass is also lighter, and offers ease of maintenance. Aluminum is now the second most used hull material. It has more strength in relation to weight than fiberglass, but it is more difficult to form. The two nationwide surveys bore out this trend in hull material for all boats. Fiberglass accounted for 44% of the hulls in 1976, 40% in 1973, aluminum 33% and 34%; and wood 10% and 15% in the two survey years. Most of the open lightweight boats, 61%, in 1976 were aluminum; 20% fiberglass. Fifty-three percent of the canoes were aluminum, 32% fiberglass. Sixty-six percent of the sailboats were fiberglass, 14% wood. Seventy percent of the open runabouts were fiberglass, 12% aluminum and 9% wood. Forty-seven percent of the cabin cruisers and houseboats were fiberglass, and 31% wood.

Looking at hull material by boat length, the 1976 survey showed that aluminum is the predominant material for the smallest boats, such as johnboats, canoes and skiffs, accounting for 47% of the boats under 16'. Fiberglass is second at 32%. Fiberglass accounted for 60% of the boats 16 to 25', aluminum 18%. Wood accounted for 47% of the boats 26 to 39', fiberglass 37%. Fiberglass accounted for 49% of the boats over 40', wood 42%.

Engine type. Marine engines are basically either inboard or outboard, jet, or inboard/outboard (outdrive). As the name implies, outboards are mounted outside the boat, on the transom. These are generally two-stroke engines designed specifically for boating. The inboards are built into the boat hull. These are usually four-stroke engines adapted from automotive engines. Inboard/outboards have the power unit inside the boat and the drive outside.

Most of the early recreational boats in the country were inboards or auxiliary-powered sailboats. The outboard was something of a novelty. The motors were bulky, heavy, hard to start, generally unreliable, and lacking in horsepower. The phenomenal growth in boating went along with the refinement of the outboard motor.

Coast Guard data on numbered boats for 1978 indicates that 84.75% are outboards and 15.25% are inboards, including inboard/outboards. The share of inboards has increased about 3% during the past ten years. The 1976 survey indicated that there were 7.8 million boats powered by outboards, including jets, 971,000 inboards, including jets, 844,000 inboard/outboards, and 123,000 other. Five and one-half percent of all boats had two or more engines for use with them. These engines were not necessarily mounted on the boat simultaneously.

Horsepower. The surveys showed, as one would expect, that the horsepower of the majority of open lightweight boats is under 30, as are the engines on auxiliary-powered sailboats. The majority of engines on the open runabouts and cabin cruisers were over 30 horsepower. A comparison of horsepower between the two survey years is made in Table 6.

Table 6.--Number of boats by horsepower (USCG 1978)

Year	Horsepower							
	None	1-5	6-10	11-30	31-50	51-100	Over 100	Total
1973	2166	1021	1276	1069	1420	1395	1257	9604
1976	3048	1208	1562	1293	1721	1867	2051	12750

Increases in the number of nonpowered sailboats and canoes accounted for the largest shares of the higher number of boats with no engines in 1976. The growth of boats in the higher horsepower categories is higher than in the lower categories. Boating industry data indicates that the average horsepower of motors sold has increased steadily. In 1969, it was 33.1 HP, and in 1979 it was 47.0 HP (MAREX 1979).

Boat age. The 1973 survey found that the average age of a boat was 8.0 years. The 1976 survey showed an average age of 8.3 years. Rowboats were the oldest, an average of 10 years. Cabin cruisers were next at 9.7 years, open runabouts 8.7 years and sailboats 8.5 years. The average age of wooden boats was 11.6 years in 1973, and 13.3 years in 1976; aluminum 7.6 in 1973 and 8.4 in 1976; and fiberglass 6.4 in 1973 and 7.2 in 1976. Fiberglass boats are expected to last about as long as aluminum boats, 12 to 20 years. Fiberglass is more easily repaired. Wood boats require more maintenance and their durability is highly dependent on the quality of wood used.

Insurance. Both surveys showed that about 62% of the boats were insured. In 1976, 41.3% of the boats that were insured had special boat insurance, 48.4% were covered under a homeowners policy and 10.3% had some other insurance.

BOAT OPERATOR PROFILE

The participation rate of the U. S. population in boating as determined by various recreation surveys have averaged about 25%. The 1976 Coast Guard survey identified 50.4 million boaters. It is safe to say that at least one in four Americans participate in boating. The boat operator is ultimately responsible for the safety of his craft and its passengers. He is therefore the primary target of boating safety education and enforcement programs. The surveys found that there were 1.8 operators per household in 1973 and 2.0 in 1976. The number of operators was 19.5 million in 1973 and 30.1 million in 1976. The various characteristics of these operators create a composite profile.

Age and Sex

The average age of all boat operators was 34 years in 1973 and 31.5 years in 1976. Table 7 profiles boat operators by age and sex for the two survey years. From the table it can be seen that the number of operators grew significantly. The number of female operators almost doubled, increasing by 89%. The number of male operators increased by 43%. In the 20 to 30 age groups, the increase in female operators was about 120%. Overall females made up 30% of the boat operator population in 1976, and 25% in 1973. The number of operators 30 years and younger relative to the total operators in each survey year increased from 49.4% to 55.9%. The trend is toward younger operators, and more female involvement. The industry-sponsored study of consumer attitudes toward recreational boating found that, "Somewhat contrary to the climate that many believe existed 10 or 20 years ago, women appeared to be generally supportive of boating as a recreational activity. Whether this stems from their recognition that boating has developed into an attractive and enjoyable family-centered recreational form, or is simply one of the corollaries of female liberation so evident in other cultural spheres, boating is no longer viewed as primarily a means of male gratification " (MAREX 1979). The Department of Commerce publication, "The Growth of Selected Leisure Industries", indicates that, "Sales of almost all types of recreational goods to women are an area of both current growth and future potential. Women of all ages and all socioeconomic levels are taking up a variety of sports, many for the first time " (DOC 1979). The publication also indicated that, "The surge in the young adult population which will continue for the next few years is favorable for most segments of the recreation industry, especially for those selling equipment for active sports and outdoor activities".

Table 7.--Boat operators by age and sex (USCG 1978)

Age	Year	Male	Female	Total
Under 12	1973	324,000	99,000	423,000
	1976	561,000	365,000	926,000
12-15	1973	956,000	415,000	1,371,000
	1976	1,695,000	721,000	2,416,000
16-19	1973	1,561,000	779,000	2,340,000
	1976	2,660,000	1,284,000	3,944,000
20-25	1973	2,082,000	839,000	2,921,000
	1976	3,626,000	1,857,000	5,483,000
26-30	1973	1,960,000	604,000	2,564,000
	1976	2,742,000	1,315,000	4,057,000
31-40	1973	2,553,000	933,000	3,486,000
	1976	3,702,000	1,753,000	5,455,000
41-50	1973	2,604,000	627,000	3,231,000
	1976	3,021,000	1,118,000	4,139,000
51-60	1973	1,562,000	357,000	1,919,000
	1976	1,954,000	513,000	2,467,000
Over 60	1973	1,033,000	173,000	1,206,000
	1976	1,021,000	188,000	1,209,000
Total	1973	14,635,000	4,826,000	19,461,000
	1976	20,982,000	9,114,000	30,096,000

Employment

The 1976 survey determined the labor force participation of primary boat operators over 16 years old. The primary operator is defined as that operator in a boating household who had the most operating time in the survey year. The employment status of primary operators as compared to the U. S. population is shown in Table 8. It shows that the percent of employed and full time student primary operators is much higher than the comparable segments of the U. S. population. The percent of houseworker primary operators is drastically lower. It is safe to assume that a great many are secondary operators, however.

Table 8.--Labor force participation of primary operator over 16 years old (USCG 1978)

Employment status	Primary operators		
	Number[a]	Percent of total	Percent census data[b]
Employed	11,162,000	77.6	59.0
Unemployed	270,000	1.9	4.7
Student, full time	1,599,000	11.1	5.3
Houseworker	248,000	1.7	22.3
Disabled (permanently)	92,000	0.6	3.6
Retired	1,025,000	7.1	5.1
Total asked	14,396,000	100.00	100.00

[a] Includes only those primary operators over 16 years old.

[b] Percent of U.S. population over 16 years old falling in each of these categories.

Job or Occupation

The 1976 survey obtained information on the job or occupation of employed primary operators over 16 years old. Table 9 shows that the percent of primary operators in major job categories is comparable to the percent of that segment of the U. S. population, with the exception of the Service Worker occupational field. Census data indicate that 13.8% of the employed U. S. population over 16 years old in 1976 were service workers, but only 6.4% of primary boat operators were. There are some significant differences within the major occupational groupings. For example, the professional and managerial white-collar workers account for 43.5% of the employed primary operators, while their share of the U. S. population is 25.6%. On the other hand, the clerical white-collar workers accounted for only 2.5% of the primary operators. Census data showed 17.8% falling in this category. Many of these are probably secondary boat operators in the household. The industry-sponsored survey of consumer attitudes found percentages in the major occupational groupings to be very close to those determined by the Coast Guard survey (MAREX 1979). The industry survey showed 52% of male boat owners to be white collar workers, 45% blue collar/farm workers and 9% retired/unemployed.

Table 9.--Job or occupation of primary operators (USCG 1978)

Job or occupation	Number[a]	Percent of total	Percent census data[b]
White-collar workers	5,400,000	52.8	49.8
Professional, technical	2,656,000	26.0	15.1
Manager or administrator (except farm)	1,791,000	17.5	10.5
Sales worker	701,000	6.8	6.4
Clerical or kindred worker	252,000	2.5	17.8
Blue-collar workers	3,701,000	36.2	33.0
Craftsman or kindred worker	1,708,000	16.7	12.9
Operator (except transport)	634,000	6.2	11.4
Operator of transport equipment	528,000	5.2	3.8
Laborer (except farm)	831,000	8.1	4.9
Farm workers	474,000	4.6	3.4
Farmer or farm manager	292,000	2.8	1.9
Farm laborer or foreman	182,000	1.8	1.5
Service worker	655,000	6.4	13.8
Total[c]	10,230,000	100.0	100.0

[a] Includes only those primary operators over 16 years old who are employed.

[b] Percent of U. S. population over 16 years old falling in these categories.

[c] Does not include Armed Services - 197,000 and 'Other' - 735,000; this was done for comparison purposes.

Schooling

A question regarding the highest grade or year of school completed by primary operators over 25 years old was asked in the 1976 survey. Table 10 portrays the results.

Primary operators have achieved a higher educational level than the comparable U. S. population. Over 50% have some education beyond high school. Almost one-third are college graduates. The industry consumer attitude survey had similar findings.

Table 10.--Highest grade or year of school completed (USCG 1978)

Grade or Year	Primary operators: Number[a]	Primary operators: Percent of total	Percent census data[b]
Less than 8th grade	251,000	2.3	11.6
Completed 8th grade	436,000	3.9	10.3
Some high school	1,165,000	10.4	15.6
High school graduate	3,492,000	31.3	36.2
Some post-high school; no college degree	2,643,000	23.7	12.4
College graduate, incl. graduate work	3,165,000	28.4	13.9
Total	11,152,000	100.0	100.0

[a] Includes only those primary operators who gave their age and were over 25 years old.

[b] Percent of U. S. population over 25 years having completed these categories.

Income

The 1976 survey did not include any question regarding income. The 1973 survey provided the following household income data: 28.5% under $10,000 per year, 32.9% ten to $15,000, 18.4% fifteen to $20,000, 8.6% twenty to $25,000, and 11.6% over $25,000 per year. Nearly 62% of the boating households had income of less than $15,000 per year in 1973. The boating households had slightly higher percentages in the income categories over $10,000 as compared to the Census data for total U. S. households. The 1979 industry consumer attitude survey found a median income of $23,500 for boat owning households.

Boat Operating Experience

The 1973 survey found that 10.2% of primary boat operators had under 20 hours of operating experience. In 1976, 15% had under 20 hours, 23.3% had 21-100 hours, 26.0% had 101-500 hours, and 35.7% had over 500 hours. There was a slight downward trend in boat operating experience.

BOAT USE

Boating Exposure

Determination of the amount of time boats are used is necessary to assess whether any particular types of boats are generally less safe than others.

Therefore, a major purpose of the surveys was to develop these estimates. Each boat owner was asked the number of months the boat was used during the survey year, the average number of outings per month, and the hourly length of an average outing.

Months used. There were 1,428,000, or 11.2%, of the 12,750,000 boats estimated by the 1976 survey not used at all during 1976. Of those that were used, 35% were used up to three months of the year, 79% were used six months or less. No particular type of boat stood out as to monthly use patterns.

Of the boats that were used during 1976, 11.5% were used only one time per month and 17.3% twice. Almost 70% of the boats were used six or less times. Seventeen percent were used more than ten times.

Outing length. The average number of hours per outing of boats used in 1976 was 5.3. Forty-six percent of the boat outings were from two to four hours, 22.3% were over six hours.

Boat hours. Based upon the monthly use and length of outing data, the number of boat hours was computed. The total number of boat hours in 1976 was 2.26 billion, and 1.55 billion in 1973. The exposure per boat went from 190 hours in 1973 to 199 hours in 1976. The runabout accounted for the largest single boat type percent share of boat exposure hours, 26.7% in 1976. The various types of open lightweight boats with motors accounted for 29.9%, and without motors 3.3%. Sailboats without motors accounted for 7.1%, and with motors 3.3%. Cabin cruisers accounted for 7.7% of the 1976 boat exposure hours.

Boats with motors accounted for 84% of the 1976 boat exposure hours, and 87% of the 1973 boat exposure hours. Boats without motors accounted for the remaining 16% of the boat exposure hours in 1976, and 13% in 1973. The largest single change between 1973 and 1976 in the boat type categories that are directly comparable is a 3% increase in the sailboat without motor exposure hours.

Passenger hours. The average number of passengers on board boats was obtained through the surveys. These data were used to convert boat exposure data to passenger exposure information. There were 7.6 billion passenger hours in 1976. This is about 3 billion more than in 1973, when approximately 3 million boats less operated. According to the 1973 survey data there were 3 passengers, on the average, for every hour of boat operation. This ratio increased to 3.4 in 1976.

The types of boats accounting for the greatest shares of passenger exposure hours in 1976 include: runabouts 27.5%, open lightweight boats 23.0%, cabin cruisers 13.8%, and sailboats 9.8%. Houseboats averaged the most passengers carried per boat, 6.6, however this type of boat only accounted for 1.7% of the total passenger exposure. Cabin cruisers averaged 6.1 passengers, and sailboats with motors 4.8.

Trailering of Boats

Trailering or carrying his boat gives the boater the flexibility to choose a boating area suitable to his purposes. The range and variety of boating locations afforded by trailering is appealing to a great number of boaters as evidenced by the 1976 survey data. The survey indicated that 62.7% of the boats, about 8 million, were trailered or carried to a launching site. Boats under 16 feet accounted for 58.8% of the boats trailered, and those 16 to 25 feet accounted for 40.6%. As to type of boat, 66.7% of the runabouts, 66% of the open lightweight boats, 46.4% of the sailboats, and 34% of the cabin cruisers are trailered or carried. Survey respondents were asked the number of miles, round trip, they normally trailered or carried their boat on each outing. The results were that 29.3% trailered less than 10 miles, 35.9% between 11 and 50 miles, 17.1% between 51 and 100 miles, and 17.7% over 100 miles. The effects of fuel prices and availability on the distances boats are trailered will be an interesting trend to observe.

BOATING ACCIDENTS

Boating is fun. Unfortunately, the fun in boating can be marred by the consequences of a boating accident. The unfamiliarity of the water environment which makes boating an enjoyable break from the daily routine, also poses a danger to those who may be unaware of the possible hazards. The Coast Guard has published annually for 20 years statistical information gleaned from boating accident reports received. This information, together with the boating survey and any other pertinent data available, is analyzed to determine safety problem areas and program effectiveness.

The reporting of fatalities is within the 95 to 100% range. Therefore, fatality data is the most complete and reliable source of boating safety trend data. The fatality rate per 100,000 boats is one overall indicator of boating safety. The rate of fatalities per 100,000 boats has been cut in half over the last ten years, going from 19.6 in 1968 to 9.4 in 1978. The actual number of boating fatalities in 1978 was 1,321. The highest rate computed was 21.4 fatalities per 100,000 boats in 1965. The major types of boating casualties are capsizings, which accounted for 35.5% of the boating fatalities in 1978; falls overboard, which accounted for 27.2% of the fatalities; collisions, accounting for 44.1% of the reported injuries and 35.6% of the reported property damage; and fires and explosions, accounting for 28.4% of the reported property damage.

Boats Involved

The prevalent characteristics of the boats involved in the largest share of the fatalities are generally not surprising having looked at the characteristics of all boats through the survey data. The percentages included in Table 11 reflect the number of fatalities in 1976 related to the particular boat characteristics listed. Factors referred to as "unknown" were eliminated. Only those characteristics accounting for at least 20% of their particular category were included in the table with the exception of the manual propulsion item which in 1976 was under 20%, but is included for comparative purposes.

Table 11.--1976 Fatalities by boat characteristics
(USCG 1977)

Primary boat characteristics	Percent of fatalities
Type	
Open motorboat	[illegible]
Length	
Less than 16 feet	58.2
[illegible] feet	35.8
Hull material	
Aluminum	40.7
Fiberglass	38.9
Propulsion	
Outboard	57.7
Manual (oars, paddle)	19.0
Horsepower	
[illegible]	30.3
[illegible]	20.7
[illegible]	21.6
Age	
Under 5 years	54.0
Over 10 years	22.5

Boat Operators

The following operator information was computed based upon those descriptors which were specified in the 1976 reports of fatalities. The age of the operator involved in 28.7% of the fatalities was 25 or under, 50.9% between 26 and 50 and 20.4% over 50 years. The 1976 survey indicated that the number of operators 25 or under was 13.7% higher than the number involved in fatalities in 1976, the 26 to 50 age category was 5.5% lower, and the over 50 years category was 8.2% lower. As for experience, 19.9% of the fatalities in 1976 involved operators with less than 20 hours of operating experience, 27.9% with 20 to 100 hours, 23.6% with 100 to 500 hours, and 28.6% with over 500 hours. These percentages are within five percentage points of the comparable categories of operator experience in the 1976 survey.

Exposure

Going a step farther in accident analysis, we can look at the fatalities in terms of boater exposure. Fatalities per million passenger hours dropped from .38 in 1973 to .17 in 1976. Based on the boater exposure by boat type data in the 1976 survey and the 1976 boating fatality statistics, fatality rates by boat type were computed. It was found that the open lightweight boats without motor topped the list with about 1.8 fatalities per million passenger hours. These are the types of boats on which most of the falls overboard and capsizings occur, and these types of casualties account for the greatest share of the fatalities.

Comment

These are but brief examples of how the data collected by the Coast Guard are used. Like virtually all data, these data have limitations. Reliance on individual reporting and availability of sufficient funds for more extensive data gathering are two constraints. We continuously strive to improve the information base using experience gained in collecting and working with the data. Other valuable sources of data are sought out and considered in the interest of developing the most representative picture of boating in the United States. The picture that has emerged is one of a continuously growing form of outdoor recreation which enjoys a broad base of participation.

LITERATURE CITED

International Marine Expositions, Inc. 1979. The non-boater: something of value, 29 p.

International Marine Expositions, Inc. 1979. Boating '79, 8 p.

Outdoor Recreation Resources Review Commission. 1962. Outdoor recreation in America, 246 p.

United States Coast Guard. 1969-1978. Boating statistics. CG-357, 39 p.

United States Coast Guard. 1978. Recreational boating in the continental United States in 1973 and 1976: the nationwide boating survey, 121 p.

United States Department of Commerce. 1979. The growth of selected leisure industries, 41 p.

TRENDS IN RIVER RECREATION[1]

Earl C. Leatherberry, David W. Lime, and Jerrilyn LaVarre Thompson[2]

Abstract.--Participation in river recreation has been expanding at a rapid rate. This paper reviews selected phenomenon associated with the growing popularity of rivers as recreational resources. The paper will: (1) describe the river recreation resource (the supply situation); (2) present selected indicators of increased river recreation use (the demand situation); (3) present demographic and experience profiles of selected river recreation users; (4) describe some of the environmental and social impacts occurring from increases in river recreation activity; (5) present selected management strategies used to cope with impacts; and (6) speculate some future trends in river recreation.

Interest in rivers for recreation is expanding rapidly. All types of rivers--urban and rural, placid and fast flowing, polluted and clean--are being used increasingly for recreation. And, people are using rivers for a wider variety of leisure activities. Besides water activities such as swimming, fishing, boating, kayaking, and waterfowl hunting, other activities, such as camping, hiking, picnicking and relaxing are often pursued with rivers as an important backdrop.

Rivers used for recreational purposes vary in length and size, and traverse private as well as public lands. Management responsiblility is often fragmented, or altogether absent. Recreation use often coexists (sometimes controversially) with nonrecreation uses such as hydroelectric power production, irrigation, timber harvesting, mining, grazing, and nonrecreational commercial traffic. Many of America's rivers, however, offer recreation in a relatively natural or naturally-appearing setting where there are few human-made features and the chance for solitude is fairly high.

The purpose of this paper is to assemble information on trends in river recreation, especially (1) supply, (2) demand, (3) who users are and what they are like, (4) environmental and social impacts, (5) present management techniques, and (6) the future. We focus on those rivers with frequent canoeing, rafting, innertubing, motorboating, fishing, and a variety of shore uses such as hiking, camping, and picnicking. We did not include recreation on large rivers having substantial commercial traffic and large pleasure craft, such as the Lower Mississippi, Ohio, Hudson, Sacramento, and Columbia Rivers.

Despite the dramatic growth in the amount and variety of literature about river recreation (Anderson _et al_. 1978) in the last half decade, as well as interest by public administrators, planners, managers, researchers, and the public, there is little information on trends _per se_. Thus, the paper is intended to assemble much of what is known on this subject.

SUPPLY OF RIVER RECREATION

There are more than 3.2 million linear miles of rivers and streams in the continental United States (Water Resources Council 1968). Alaska has another 365,000 miles. It is difficult to delineate those portions that are utilized for recreation. We do know, however, that most rivers and streams are too small to support on-water recreational activities. For example, only about 700 streams with a combined length of 100,000 miles have a minimum flow of at least 500 cubic feet per second--the minimum flow desirable for on-water recreational activities (Water Resources Council 1968).

---

[1] Paper presented at the National Outdoor Recreation Trends Symposium, Durham, NH, April 20-23, 1980.

[2] The authors are, respectively, Geographer, Research Social Scientist, Forester, U.S. Dep. Agric. For. Serv., North Central Forest Experiment Station, 1992 Folwell Avenue, St. Paul, MN 55108.

Obviously, not all of this is available for recreation. Much is exploited for nonrecreational uses, resulting in pollution or reduced flow. Other rivers are not readily accessible to the public. Some are far removed from population centers, and others, although near or in densely populated urban areas, are virtually inaccessible because they are bordered by private land, or access is limited, or both.

Because of the lack of "hard" data about the supply of river recreation resources nationwide, the Heritage Conservation and Recreation Service (HCRS) is conducting an inventory of rivers to provide a reliable data base for the nation's river resource. The inventory will also identify the highest quality rivers for possible consideration under federal, state, or local river preservation programs. The national inventory is being conducted in two phases. The first phase focuses on the natural qualities of rivers. All river segments over 25 miles in length are screened against various criteria, mostly factors relating to the extent of human intrusions. The second phase began in 1979 and will identify rivers greater than 5 miles in length with high recreation and aesthetic values that are readily accessible to urban areas.

Most national information comes from rivers specially designated under federal and state programs. The federal Wild and Scenic Rivers System preserves many of the nation's outstanding free-flowing rivers. The system was established in 1968 with eight rivers, and identified 27 additional rivers to be studied for inclusion in the system. Growth in the system was slow; a total of 15 rivers were authorized by 1975. Then between 1976 and 1978 13 additional rivers were authorized as components of the system. Currently the system contains 28 rivers or river segments, totaling 2,318 miles (Table 1). An additional 48 rivers have been designated for study as potential components. Other rivers or river segments including the Current and Jack Fork Rivers in Missouri and the Buffalo River in Arkansas have been designated National Scenic Riverways.

In addition to federal efforts to preserve river resources, 23 States have established river preservation programs (Table 2). The first statewide program was established in Wisconsin in 1965. States passing legislation jumped from 3 in 1968 to 19 in 1972. Since 1975 no new State legislated programs have been implemented, but there are indicators that 40 States are active in river protection efforts (Alling and Ditton 1979). To date, 19 States have designated over 200 rivers or river segments, totaling nearly 6,000 miles. Unlike the federal program, which is uniform in intent and purpose, state programs range from active, dynamic planning to merely token efforts having minimal adminstrative responsibilities.

DEMAND FOR RIVER RECREATION

An extensive national survey by the U. S. Coast Guard revealed that the number of kayaks and nonmotorized canoes owned by Americans has grown disproportionately faster than any other type of craft (U. S. Department of Transportation 1978). Between 1973 and 1976, for example, there was a 68 percent increase in the number of canoes and a remarkable 107 percent increase in the number of kayaks. Presently there are an estimated 1 million canoes and 90,000 kayaks nationwide. In Minnesota the growth in canoe and kayak ownership is particularly dramatic. Between 1972 and 1978, the estimated state population increased 3 percent; during the same period the number of canoes and kayaks registered with the Department of Natural Resources increased 143 percent, from 41,675 to 101,322 (State of Minnesota 1979).

There are substantial regional differences in canoe and kayak ownership patterns in the contiguous 48 States. Data from the National Boating Survey in 1973 (U. S. Department of Transportation 1974) and population figures from the same year reveal that the number of canoes owned in the New England and Lake States per unit population is higher than average, while canoes per unit population in the Gulf Coast, East Central, and West Coast regions is lower than average. Kayak ownership per unit population in the New England, Mid-Atlantic, and West Coast regions is high compared to the average, while kayak ownership per unit population in the Gulf Coast, East Central, Midwest/Mountain, and Great Lakes regions is lower.

Some of the most striking ownership patterns are in the New England, Great Lakes, and West Coast regions. New England accounts for roughly 15 percent of the population but 26 percent of the canoe ownership and 29 percent of the kayak ownership. The Great Lakes region has 30 percent of the canoes but only 5 percent of the kayaks, while making up 21 percent of the population. Conversely, the West Coast region, with 13 percent of the population, has only 4 percent of the canoes but 36 percent of the kayaks.

All data, sketchy as they are, show a steady upward trend in river recreation from the late 1960's on (Table 3). On many rivers the number of visitors increased by as much as 20, 50, or even 100 percent per year. Rivers

Table 1.-- River mileage classifications for components of the national wild and scenic rivers system as of December 1979[a]

Rivers in the national system	Designated	Administering agency	Wild	Scenic	Recreational	Total
	Year		- - - - - - -	- - - - - - -	Miles - - - - - - -	- - - - - - -
1. Middle Fork Clearwater, Idaho	1968	USFS	54	--	131	185
2. Eleven Point, Missouri	1968	USFS	--	44.4	--	44.4
3. Feather, California	1968	USFS	32.9	9.7	50.4	93
4. Rio Grande, New Mexico		BLM/USFS	51.75	--	1	52.75
(Rio Grande Mgt. by Agency)		(BLM)	(43.90)	--	(0.25)	(44.15)
	1968	(USFS)	(7.85)	--	(0.75)	(8.60)
5. Rogue, Oregon		BLM/USFS	33	7.5	44	84.5
(Rogue Mgt. by Agency)		(BLM)	(20)	--	(27)	(47)
	1968	(USFS)	(13)	(7.5)	(17)	(37.5)
6. St. Croix, Minnesota and Wisconsin	1968	NPS/FS	--	181	19	200
7. Middle Fork Salmon, Idaho	1968	USFS	103	--	1	104
8. Wolf, Wisconsin	1968	NPS	--	25	--	25
9. Allagash Wilderness Waterway, Maine	1970	State of Maine	95	--	--	95
10. Lower St. Croix, Minnesota and Wisconsin	1972	NPS	--	12	15	27
11. Little Miami, Ohio	1973	State of Ohio	--	18	48	66
12. Chattooga, N.C., S.C., and GA.	1974	USFS	39.8	2.5	14.6	56.9
13. Little Beaver, Ohio	1975	State of Ohio	--	33	--	33
14. Snake, Idaho and Oregon	1975	USFS	32.5	34.4	--	66.9
15. Rapid, Idaho	1975	USFS	24	--	--	24
16. New, North Carolina	1976	State of NC	--	26.5	--	26.5
17. Lower St. Croix, Minnesota and Wisconsin	1976	States of MN, WI	--	--	25	25
18. Missouri, Montana	1976	BLM	72	18	59	149
19. Flathead, Montana	1976	FS/NPS	97.9	40.7	80.4	219
20. Obed, Tennessee	1976	NPS/State of TN	45.2	--	--	45.2
21. Pere Marquette, Michigan	1978	USFS	--	66.4	--	66.4
22. Rio Grande, Texas	1978	NPS	95.2	96	--	191.2
23. Skagit, Washington	1978	USFS	--	99	58.5	157.5
24. Upper Delaware, New York and Pennsylvania	1978	NPS	--	25.1	50.3	75.4
25. Middle Delaware, New York, PA and NJ	1978	NPS	--	35	--	35
26. American (North Fork), California	1978	USFS/BLM	38.3	--	--	38.3
		(USFS)	(26.3)			
		(BLM)	(12)			
27. Missouri, Nebraska, and South Dakota	1978	Interior/Corps of Engineers	--	--	59	59
28. Saint Joe, Idaho	1978	USFS	26.6	--	46.2	72.8
		TOTAL	841.15	774.2	702.4	2,317.75

[a] U.S. Department of the Interior, Heritage Conservation and Recreation Service.

Table 2.--Twenty-three state river protection programs[a]

State	Year legislation enacted	Rivers designated to date	River miles designated to date	Rivers considered for future designation	Ownership of majority of corridor	Protective features of the program: Prohibit instream modifications	Protective features of the program: Land use controls	Protective features of the program: Management of use and users
California	1972	9	1,030	N/A	Both	Yes	Yes	Yes
Georgia	1969	0	0	115	N/A	Yes	Yes	Yes
Indiana	1973	2	59	N/A	Private	Yes	Yes	Yes
Iowa	1970	1	80	0	Private	No	No	No
Kentucky	1972	8	110	0	Public	Yes	Yes	Yes
Louisiana	1970	43	N/A	N/A	Private	Yes	No	Yes
Maryland	1969	9	441	0	Private	Yes	Yes	No
Massachusetts	1971	0	0	1	Private	Yes	Yes	Yes
Michigan	1970	6	641	25	Private	Yes	Yes	No
Minnesota	1973	4	200	14	Private	No	Yes	Yes
New York	1972	70	1,214	60	Private	Yes	Yes	Yes
North Carolina	1971	2	36	4	Both	Yes	Yes	Yes
North Dakota	1975	1	213	3	Private	Yes	No	No
Ohio	1968	8	415	4	Private	Yes	Yes	Yes
Oklahoma	1969	5	151	0	Private	Yes	No	No
Oregon	1970	8	523	6	50/50	Yes	Yes	Yes
Pennsylvania	1972	0	0	112	Private	Yes	No	Yes
South Carolina	1974	2	60	20	Private	N/A	N/A	N/A
South Dakota	1972	0	0	2	Private	Yes	Yes	Yes
Tennessee	1968	11	350	0	Private	Yes	Yes	Yes
Virginia	1970	2	53	35	Private	Yes	No	Yes
West Virginia	1969	5	205	0	Private	Yes	No	No
Wisconsin	1965	3	91	0	50/50	Yes	Yes	Yes
	TOTAL	199	5,872	401				

[a] Alling and Ditton (1979).

Table 3.--Recreation use, in visits, of selected U.S. rivers by region (1965-1979)[a]

River by Region	Number of visits for years data have been collected[b]														
	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
EAST															
Allagash River (Maine)	—	4,141	4,539	3,789	4,820	5,460	6,345	8,260	8,337	7,477	9,447	8,619	9,278	9,734	8,932
Youghiogheny River (Pa.)	—	—	—	—	—	17,000	—	—	—	80,000	—	—	—	—	—
St. John's River (Maine)	—	—	—	—	—	—	—	—	—	—	1,151	1,294	2,408	2,639	2,971
MIDWEST															
Buffalo River (Ark.)	—	—	—	—	—	—	—	—	—	15,505	18,748	—	—	—	—
Current River, Ozark Nat. Scenic Riverway (Mo-Ark)	—	40,000	—	—	—	—	—	—	—	164,500	202,857	—	242,000	—	—
Eleven Point River (Mo.)	—	—	—	—	—	—	—	—	—	—	—	—	10,528	11,128	9,906
Pine River (Mich.)	—	13,000	—	—	—	—	50,000	—	64,000	—	80,000	90,000	96,000	76,341	69,836
Upper Iowa River (Iowa)	—	—	—	—	—	—	—	1,464	1,795	—	—	—	—	—	—
St. Croix River, Upper (Minn-Wis)	—	—	—	—	—	—	—	—	—	—	—	—	—	117,000	118,000
St. Croix River, Lower (Minn-Wis)	—	—	—	—	—	356,000	—	—	—	—	—	—	832,649	—	—
WEST															
Colorado River, Cataract Canyon, Canyonlands Nat. Pk. (Utah)	—	—	—	—	585	889	1,670	2,439	4,422	4,096	4,042	4,869	4,809	5,595	5,786
Colorado River, Grand Canyon Nat. Pk. (Ariz.)	547	1,067	2,099	3,609	6,019	9,935	10,885	16,432	15,219	14,253	14,305	13,912	11,830	14,356	14,576
Colorado River, Westwater Canyon, (Colo.-Utah)	—	—	—	—	—	318	—	500	—	—	—	—	4,496	6,586	7,181
Delta River, (Alaska)	—	—	—	—	—	—	—	356	—	—	888	800	1,500	1,550	2,511
Gulkana River, (Alaska)	—	—	—	—	—	—	—	—	—	—	500	433	450	500	607

(Continued)

Table 3.--Continued

Green and Yampa Rivers Dinosaur Nat. Monuments (Colo.-Utah)	--	--	2,493	3,755	5,740	9,762	14,145	17,159	16,739	12,874	13,710	13,580	13,114	14,559	12,803
Green River, Desolation Canyon, (Utah)	--	--	--	--	--	1,600	--	--	--	--	--	5,189	4,946	5,941	5,793
Owyhee (Oregon)	--	--	--	--	--	--	--	--	--	482	557	738	80	989	1,483
Rio Grande River, Big Bend Nat. Pk. (Texas-Mexico)	926	1,540	2,741	2,389	3,996	4,006	4,478	4,421	4,850	7,651	6,069	4,823	5,421	4,157	3,178
Rogue River (Oregon)	--	--	--	--	--	--	2,800	4,800	5,885	7,210	8,855	10,836	--	--	--
Salmon River, Middle Fork (Idaho)	1,260	1,260	1,299	1,396	1,624	3,028	3,250	3,972	4,372	4,036	4,682	5,964	3,767	6,904	7,026
Salmon River, Lower Main (Idaho)	--	--	--	--	--	--	--	--	4,003	3,057	2,477	3,955	3,817	4,569	6,089
Salmon River, Upper Main (Idaho)	--	--	--	--	--	--	--	--	2,593	2,931	3,201	--	--	--	--
Selway River (Idaho)	--	--	--	--	--	46	194	406	419	439	345	350	359	441	629
Snake River, Grand Teton Nat. Pk. (Wyo.)	--	18,000	--	--	--	--	--	71,256	73,885	51,906	83,096	77,412	81,210	87,925	--
Snake River, Hell's Canyon (Ore.-Idaho)	--	--	--	--	--	--	--	--	1,184	1,485	1,797	2,118	2,474	3,213	4,276
Snake River, Grand Canyon (Wyo.)	--	--	--	--	--	--	--	--	27,364	30,462	43,576	55,739	60,914	68,959	--
Stanislaus River (Calif.)	--	--	--	--	--	--	--	25,000	31,807	29,180	--	--	--	34,683	--
Toulumne River (Calif.)	--	--	--	--	--	--	--	--	--	--	2,700	596	0	3,330	3,550
SOUTH															
Chattooga River (So. Carolina, Georgia)	--	--	100	100	300	800	800	7,600	21,000	28,800	22,800	15,200	17,400	29,000	28,800
Everglades Canoe Trails (Fla.)	--	--	--	--	--	--	--	--	4,000	5,000	--	--	--	--	--
Nantahala River (No. Carolina)	--	--	--	--	--	--	--	1,000	3,000	4,000	--	--	--	--	--
Okefenokee Canoe Trails (Georgia)	--	--	--	--	--	--	300	500	800	2,000	--	--	--	--	--
Hiwassee (Tennessee)	--	--	--	--	--	800	1,200	--	2,000	3,000	--	--	--	--	120,000
Ocoee (Tennessee)	--	--	--	--	--	--	--	--	--	--	--	--	7,000	23,000	40,000

---

[a] Expanded from Hecock (1977).

[b] Data from various published and unpublished sources.

owing the greatest increases are nearest rge population centers in the Midwest, East, d far West.

The upward trend in river recreation has d public agencies to restrict use on some vers. Rivers with some use restrictions creased from 8 in 1972 to 38 in 1977 (McCool al. 1977, Utter 1979). As a result use on ese rivers has been stable or has even clined (Table 3). We suspect, however, that asures to limit use, while effective at their tended locales, have caused corresponding amatic increases on other rivers where no strictions yet exist.

Closely associated with the trend toward eater regulation of use on rivers has been e trend toward potential users being denied cess to rivers (Grimm and Wyman 1974). On ny rivers the number of persons applying for rmits has been four to five times the number ceiving them. For instance, on the Selway ver in 1978, only 62 of the 703 persons plying for a permit through a lottery system tually were awarded one--a 9 percent rate of ccess.

Growing membership in river-oriented orga- zations, sponsored river events, and the cir- lation of magazines oriented to river creation all point to an accelerated interest rivers for recreation. For example, mem- rship in the American Canoe Association was 000 in 1965 and is expected to exceed 5,000 ring 1980. The number of Sierra Club river tings has more than doubled since 1969, up to in 1978. Circulation of Canoe Magazine, ich began publication in 1973, jumped from 000 in that year to over 45,000 in 1979.

Commercial enterprises in river creation have correspondingly increased. For ample, the Grumman Rent-A-Canoe directories rumman 1973, 1978) show canoe rental agencies sted increased 115 percent between 1973 and 78 (from 427 to 917). Enterprises and indi- duals that outfit or lead river trips also ve increased. The newly formed National sociation of Canoe Liveries and Outfitters port 168 businesses in 33 States in their 79 directory. They expect the number of sinesses to at least double in the 1980 rectory (Couch 1979). In 1962, the Western ver Guide Association counted only 15 mem- rs. By 1979, the number of members had risen 1,374. The companion Eastern Professional River Outfitters Association was founded in 1976 with 14 members. Three years later the organization had more than doubled to 29.

Full-time lobbyists for several conservation organizations with a vital interest in river protection as well as recreation use have been established. The American Rivers Conservation Council, for example, was founded in 1973, and is based in Washington, D. C. A major national lobby, they call for widespread river preservation programs and for informing a variety of interested persons about river planning, management, and conservation.

The growing number of regional, national, and international conferences and symposia focusing specifically on river recreation is another indicator of the widespread interest in river resources. During the 1970s, no less than 10 major gatherings focused on such topics as river planning and management, the impact of proposed dam construction on river resources, in-stream flow requirements for recreation and other uses, research on river recreation, and public programs to preserve river environments.

The following factors should be influential in keeping demand high: the crowded conditions associated with other recreation activities; the reduction in pollution on many waterways (especially in and near urban areas) resulting from legislation such as the Water Quality Act of 1965; the increased emphasis on physical fitness; a surge in interest by people in challenging, even dangerous recreation activities; the growing number of books, magazines, films, advertisements by commercial river outfitters, and television programs on the out-of-doors and rivers in particular; growth in the number of commercial outfitters and boat liveries that provide relatively inexpensive services to a broadening, inexperienced segment of society; and, new technology in outdoor recreation equipment and related industries (Lime 1977a).

THE RIVER RECREATIONISTS: WHO ARE THEY?

As river recreation has increased so have studies of river recreationists to determine their social and economic makeup, why they visit rivers, reactions to encountering various amounts and types of river users, opinions of specific river management practices, etc. (Anderson et al. 1978). Unfortunately, most studies of river use and users have been one-time efforts without follow-up inquiry. And, most have been case studies of short duration using different survey techniques (Anderson et al. 1978). However, there is enough evidence from various studies to make some tentative observations about these recreationists. Generally, river recreationists are atypical of the population as a whole, as frequently reported in analyses of other outdoor recreationists. However, there are characteristics of river recreationists that distinguish them from other outdoor recreationists.

River recreationists here are defined as people who travel on rivers or streams in rafts, canoes, kayaks, innertubes, or relatively small motorboats, but not large motorized watercraft or sailboats. Fishermen, shore users, and riparian landowners are also excluded.

Most studies have shown that river recreationists are predominantly young (Hecock 1977). Data from the 1978 phase of the Forest Service's National River Recreation Study[3] revealed that 67 percent of the river recreationists surveyed were between the ages of 20 and 40, and 45 percent were between 20 and 30 years of age. Similar distributions are found in other studies of river recreationists (Bassett et al. 1972, Heberlein and Vaske 1977, Seitz 1974, Solomon and Hansen 1972).

Certain ages are associated with certain craft. Tubing enthusiasts tend to be younger than other river recreationists. On the Apple River in Wisconsin, for example, more than two-thirds of the tubers surveyed were under 25 years of age (Shaffer and McCool 1973). Youthfulness among tubers is further exemplified from a study on the Bois Brule River, also in Wisconsin (Heberlein and Vaske 1977). At least 30 percent of the tubers were judged to be under 14. In contrast, youthfulness is not a dominant characteristic of whitewater enthusiasts, perhaps because that activity requires considerable investment in equipment and/or commercial services (Hecock 1977). On the Colorado River in the Grand Canyon, for example, the average age of rafters was 36 (Shelby 1975). Similar patterns have been reported from other studies (Howard et al. 1976, Schreyer and Nielson 1978).

As with many outdoor recreational pursuits, river recreationists are often students and more educated than average. Most past age 18 have completed several years of formal training beyond high school. Half of those over 18 years in the National River Study (1978 data), for instance, had completed at least 4 years of post high school training. Similarly, Schreyer and Nielson (1978) found that about a third of the visitors surveyed on two whitewater rivers in Utah had completed more than 4 years of training beyond high school. And, Leatherberry (1979), found both canoe and kayak owners in Minnesota, on the average, had completed more than 2.5 years training after high school.

More river recreationists are professionals or white-collar workers than average and have higher incomes (Boster 1972, Heberlein and Vaske 1977, Howard et al. 1976, Leatherberry 1979, Pfister and Frenkel 1974, Seitz 1974, Solomon and Hansen 1972). The National Recreation Survey (Bureau of Outdoor Recreation 1973) found that canoeists have higher incomes than most other outdoor recreationists and the population as a whole. Leatherberry (1979) in Minnesota found that a fifth of the State's households had annual incomes in excess of $25,000 in 1976 while about a third of the canoe and kayak owner families had incomes exceeding that figure.

In general, river recreationists begin participating at a later age than others such as hunters, fishermen, and wilderness visitors (Hendee et al. 1968, Klessig and Hale 1972). For example, canoe owners in Minnesota, on the average, went on their first canoe outing when they were 20 years old; kayak owners were 26 (Leatherberry, 1979).

River recreationists are unique in that so many are newcomers to a given river and to river recreation in general. In Hecock's review (1977) he found no studies where first-time visitors accounted for less than a third of the total population studied. The pattern has remained constant in studies completed since then (e.g., Schreyer and Nielson 1978, Heberlein and Vaske 1977). In the National River Recreation Study (1978 data), 56 percent of all respondents had never before been on the river where they were sampled. However, there was considerable range in the percentage of first-time visitors--from 23 percent on the Salt River, a tubing river in Arizona, to 74 percent on the Colorado River, a whitewater stream, in central Colorado.

---

[3] The National River Recreation Study is a nationwide survey of river recreationists being conducted by the North Central Forest Experiment Station. The focus is to develop and apply standardized survey techniques for describing patterns of behavior, characteristics, and management preferences of recreation users across a variety of rivers and over time (Lime et al. 1979). So far, 39 different rivers or river stretches throughout the country (including Alaska) have been studied: 11 were studied in 1977, 13 in 1978, and 23 in 1979. Five rivers were studied in more than one use season.

Many river recreationists are novice. In the National River Study, we asked respondents to identify other river trips they had taken by innertube, canoe, raft, kayak, or other watercraft. From the 1978 phase of the study, nearly a quarter were on their first river trip.

Partly because of their lack of experience, many participants rent rather than own their watercraft. On the Pine and Au Sable Rivers in Michigan and the Current and Jacks Fork Rivers in Missouri, about 80 percent of all canoes were rentals (Bassett et al. 1972, Marnell et al. 1978, Solomon and Hansen 1972). On many whitewater rivers, particularly in the West, most participants use rented watercraft or ride in crafts piloted by commercial guides. In 1978 on the Snake River in Hell's Canyon, for example, 63 percent of all visitors travelled in commercially outfitted groups (Shelby and Danley 1979).

Most river trips involve at least some preplanning, and most river recreationists decide to go on their trip at least a week in advance. Sometimes, especially where river camping is involved, the decision is made further in advance than for day trips. For example, 52 percent of the campers in the National River Study (1978 data) decided to go on their river trip more than a month in advance. By contrast, day trippers are much more spontaneous in their planning. From the National River Study, 43 percent of the day users planned their outing no more than a week in advance--11 percent of all day users surprisingly planning their trip within 24 hours. Heberlein and Vaske (1977) found most tubers in Wisconsin did no advance planning or at most, planned 1 or 2 days ahead. Most canoeists on the Au Sable River in Michigan were day users and made plans for their trip no more than a week in advance (Bassett et al. 1972).

Although the size of groups can vary considerably among rivers and types of visitors (such as between kayakers and commercially outfitted rafters), group size tends to be considerably higher than in many other recreational pursuits such as hunting, hiking, wilderness camping, fishing, and snowmobiling. In the National River Recreation Study (1978 data), the median group size was 9 but ranged from 5 persons per group on the Salt River in Arizona to 20 persons on the Kings River in California; 11 percent of all visitors were in groups of more than 30 people. Organizational groups tend to be larger than groups of family members or friends (Marnell et al. 1978) and, in most instances groups that use commercial services are larger than privately outfitted groups. In a 1974 study of the Rogue River in Oregon, for example, 75 percent of the commercially outfitted parties ranged from 16 to 25 people while only 13 percent of the noncommercial parties consisted of that many (Pfister 1977).

River recreationists take river trips for a variety of reasons. The National River Recreation Study (1978 data) preliminary analysis suggested that among the most important reasons for taking river trips are: (1) to be with other people, (2) to escape the day-to-day demands at home, (3) to get exercise, and (4) to learn about nature. Similar results were found in other studies (Bassett et al. 1972, Heberlein and Vaske 1977, Solomon and Hansen 1972).

The reasons recreationists had for taking river trips are generally quite different than the reasons for participating in some other recreation activities. For example, data from the National River Study and from urban residents in three midwestern cities suggest that people who play sports, visit zoos and museums, or go to the theatre do so for different reasons than people who take river trips (Peterson et al. 1978). For example, people who take river trips had a stronger desire to get away from the day-to-day demands of life at home.

River recreationists often pursue activities far from home. The distance river recreationists travel may be related to the site attractiveness or site "demand" of the resource (Peterson et al. 1979). Data from the National River Study (1977 data) confirmed that whitewater rafters and kayakers tend to travel further from home than do the more casual canoeists. On the Main Salmon and Middle Fork of the Salmon Rivers in Idaho, visitors travelled an average of more than 800 miles (one way) to float those rivers. On the other hand, visitors to the Mohican River in central Ohio, a flat-water canoe stream, travelled an average of only 76 miles.

PROBLEMS ASSOCIATED WITH INCREASED POPULARITY

Multiple access and egress points, multiple land ownership patterns, variations in water flow, and a recreating public in search of a variety of outdoor experiences have caused headaches for resource administrators.

Social problems

Large groups of river recreationists often infringe on the enjoyment of smaller groups. Groups of over 120 people have been observed on Michigan's Pine River (Solomon and Hansen 1972). On Oregon's Rogue River, one party contained 38 rafts! Though only a small proportion of total use, they may have a disproportionate impact on the experience of others. Many large groups are organizations, clubs, and fraternal groups, and they float rivers primarily for a social experience. The value that large groups attach to their trip is often different from those of smaller groups (Stankey 1973, Lime 1972). Some studies have revealed that objection to seeing large groups is not so much related to their numbers but rather their inconsiderate behavior, such as yelling or shouting (Driver and Bassett 1975, Bassett et al. 1972). Often, inconsiderate behavior is related to the consumption of alcoholic beverages. On many rivers the stream bed and banks are littered with cans and bottles. Clean-up crews on the Pine River in Michigan reported 1,000 containers within a 1-mile section; most were beer cans and bottles (Marek 1979).

Congestion is a common problem on many rivers. Large "armadas" have been observed on one stretch of river while other stretches of the same river are nearly deserted (Warren 1977). These large concentrations often occur because of the seasonal, weekly, and daily peaks in use. Most trips are taken between Memorial Day and Labor Day, during the latter part of the week and on holidays, and begin in mid-morning. Since most groups travel at about the same speed, they tend to create congestion at access and egress points, campsites, rapids, and other attractions.

The congested conditions on some rivers has led to animosity among different groups of recreationists. A common situation is heavy competition for campsites, often expressed in open hostility (Warren 1977). Some recreationists resent others who use different types of watercraft. Heberlein and Vaske (1977) found canoeists consistently disliked meeting other recreationists more than tubers did. In the Boundary Waters Canoe Area Wilderness (BWCAW), Lucas (1964) and Starkey (1973) found paddle canoeists strongly objected meeting motorboaters. On the Colorado River in the Grand Canyon, recreationists travelling in oar-powered rafts objected to motorized rafts because of their noise (Shelby 1975).

Research shows that while recreationists in nonpowered craft oppose meeting motorized groups, most motorized parties don't mind meeting nonmotorized groups. In the BWCAW, for instance, nearly half of the motorboaters studied said it wouldn't matter how many other parties they met per day (Lime 1977b). Significantly fewer motor canoeists (29 percent) and paddle canoeists (13 percent) felt that way.

Some river recreationists have altered their participation patterns because of what they perceive to be unacceptable conditions. In some areas such feelings have resulted in significant numbers of recreationists being displaced. Becker and his associates in studying the St. Croix and Mississippi Rivers in southeastern Minnesota (1979), for example, found that recreationists seeking social experiences tended to gravitate to one section of the river system while those seeking low density experiences went to another section. They also found that some recreationists were purposefully avoiding areas and times when use densities were highest.

Commercial outfitters and noncommercial users often compete for the opportunity to float rivers (Utter 1979). Competition has been particularly prevalent on western whitewater rivers, but the problem is growing nationwide. The competition has resulted in direct and indirect conflicts among recreationists, expressed in threatened and actual lawsuits and Congressional inquiry. On the Colorado River in Grand Canyon, for example, a battle has been raging since the early 1970s over the 92:8 split in the allocation of use permits between commercial and private parties. The National Park Service, with support from private users, proposes to increase the proportion of private trip permits while most commercial operators want to maintain the status quo (U. S. Department of Interior 1979). Such intense debate inhibits management initiative and often results in long legal deliberations (Jensen 1979, Shelby 1979).

River recreation use causes conflicts with other uses and users of rivers. In Michigan, for example, there are several rivers with high quality trout fishing but canoeing on weekends has increased to where fishermen have found it difficult to fish. And, many have had to alter their regular fishing times or have stopped fishing those streams (Marek 1979, Bassett et al. 1972).

On some popular rivers there are conflicts between riparian landowners and river recreationists. Some of the most serious problems center around littering and trespassing (Countess et al. 1977, Cox and Argon 1979). Other conflicts arise from vandalism, invasion of privacy, and noise (Bassett et al. 1972). In some areas landowners respond by posting their land (Cox and Argon 1979) or have threatened to take or have taken the law into their own hands.

Ecological problems

Destruction of native ground vegetation is common along many streams and rivers (Aitchison et al. 1977, Manning 1979, Marnell 1978). The most common cause of vegetation destruction is trampling; but, since recreationists spend a large portion of their time on the river, impacts to ground vegetation does not occur uniformly throughout the river corridor. Instead, impacts usually are concentrated at accesses, campsites, and near other popular stopping points.

In areas where use is especially concentrated such as at campsites, studies have determined that after the first few seasons when ground vegetation is fairly rapidly reduced to some low point, there is a natural recovery or adjustment in the vegetation (Settergren 1977). Generally, however, there is a shift to more recreation-tolerant species (Merriam and Smith 1974). But under sustained use, the ground vegetation will be progressively reduced until it cannot recover naturally. On heavily used areas along the Current and Jacks Fork Rivers in Missouri, for example, researchers found that the rise in density of replacement species moderated the decline in original ground cover vegetation (Marnell et al. 1978). However, with further increase in recreation all ground vegetation was eventually lost.

The removal of trees and shrubs by recreationists is a problem where impacts are concentrated. Numbers of smaller seedlings and saplings decrease and vegetation patterns are affected over prolonged periods (Schmidly et al. 1976). Recreationists sometimes cut or remove vegetation to enlarge campsites. In the BWCAW, Merriam and his associates (1973), found that newly constructed campsites approximately doubled in size during a 3-year period.

Malicious chopping of exposed roots, trunks, or limbs, and live-tree cutting late in the use season when deadwood becomes scarce, can reduce standing vegetation (Marnell et al. 1978, Schmidly and Ditton 1978).

Loss of vegetation often results in soil erosion. On riverbanks soil erosion is accelerated because of the contour of the land and/or the properties of the soil. The sandy or depositional nature of the soil can contribute to the lack of stabilizing vegetation and erosion often is rapid and devastating. Hansen (1975), for example, found on the Pine River in Michigan that streambank erosion was dramatic as a result of recreationists sliding down steep sandy banks. Merriam and Smith (1974) found in the BWCAW that campsites were subject to considerable recreation-induced erosion. On footpaths along the Colorado River in Grand Canyon, Dolan and his associates (1974) found surface erosion up to two feet deep. The season, duration, and intensity of use influences the extent and nature of erosion in such arid environments. A site may be very durable during drier months, but heavy use during spring when the water table is higher can result in greater and more pronounced erosion.

Motor vehicle use in river corridors and in the stream bed also causes soil erosion. Tracks left by vehicles roughens the soil which accelerates erosion. Such traffic can alter the natural form and distribution of gravel deposits in stream beds and affect normal shifting and development of gravel bars (Marnell et al. 1978). Riverside campsites accessible by road also are particularly vulnerable to heavy use followed by erosion. On the Rio Grande River in Big Bend National Park, riverside auto campsites were among the most heavily used (Ditton et al. 1977); the same along Michigan's Pine River (Hansen 1975).

Sedimentation from erosion in turn affects the water quality. Increased sedimentation causes increased turbidity, nutrient enrichment, and the smothering of bottom flora and fauna. On some high quality, sensitive trout streams, for example, sedimentation has destroyed the fishery resource. In most instances, however, recreational impact is localized (Merriam and Smith 1974), and does not contribute significantly to sedimentation (Marnell et al. 1978).

Along many recreational rivers, the disposal of human waste is a serious and growing problem and a potential public health hazard. Sanitation facilities are generally not available. Improper disposal of human waste can cause biological contamination or nutrient enrichment of rivers. Merriam and his colleagues (1973) found that recreational use of some campsites increased coliform bacteria and phosphate concentrations in lake water to a point higher than public health standards allowed for drinking water. On some rivers, especially those in canyon settings, the area available for sewage burial is very limited. Aitchison and his associates (1977) report that on the Colorado River's most popular beaches in Grand Canyon National Park, it was not uncommon to uncover previous human waste sites. A number of cases of infectious illness due to inadequate sanitation practices occurred among recreationists on the river (Knudsen et al. 1977).

The severity of the human waste problem and the attendant health hazard is related, in part, to the character of the local ecosystem. On the Current River in Missouri, for instance, the warm humid climate, rich vegetation, and porous soil lessens the problem because decomposition is so rapid. Also, periodic flooding leaches residual wastes from the floodplain (Marnell et al. 1978). In contrast, on the Colorado River, the hot, dry climate prohibits the proliferation of decomposer bacteria. Harmful bacteria accumulate in beach sands, partly because an upstream dam has eliminated floods that formerly scoured and shifted beaches. Even after a year, fecal coliform bacteria of unacceptable levels were present in beach sands (Aitchison et al. 1977).

Litter or solid waste poses another challenge to river recreationists, resource administrators, and the general public. Managers on Michigan's Pine River estimated 20,000 beverage containers were strewn along a 40-mile stretch (Doehne 1977). Recreationists there are sensitive to this problem. When a sample of canoeists were asked what was "the low point of your river trip", litter was the most frequent complaint (Solomon and Hansen 1972). Besides being aesthetically unpleasing, litter or solid waste is a potential human health hazard because it creates a potential food supply for insects and animals. The artificial food supply may lead to unnaturally high densities of some mammals which can lead to poor health among populations and transmittal of diseases (Aitchison et al. 1977).

RESPONSE TO RIVER RECREATION POPULARITY

Before the 1960s, active river recreation management was virtually nonexistent. However, some federal agencies and state governments did attempt to protect free-flowing rivers in their natural state, but most efforts were rather passive with few or no provisions for recreation management. Any management that was done was largely secondary or incidental to other concerns such as watershed protection, irrigation, and hydroelectric production. Some State and Federal agencies that owned riparian lands, did provide facilities such as boat ramps, campsites, and picnic tables. State agencies and the U. S. Coast Guard were responsible for management, most of which centered on enforcing compliance to federal and state water regulations, license requirements, and site maintenance.

As river recreation use grew during the late 1960s and early 1970s, the need for strong management became evident. In 1968 the national Wild and Scenic Rivers Act (Public Law 90-542) was established to preserve certain selected rivers in a free-flowing condition. That same year the President's Council on Recreation and Natural Beauty (1968) recommended a nationwide protection of natural rivers through State action. Legal efforts such as the national Wild and Scenic Rivers Act, and State programs, helped focus attention on rivers as recreational resources but they did not mandate specific actions. These were left to the field units.

During the 1970s, management activities proliferated--especially establishing management objectives. Managers tried to define the type of recreation experience the river environment would provide by deciding what kinds and amounts of use to allow on the river.

Management ranged from trying to change behavior by rules and regulations to trying to change it by suggestion through printed and spoken media. Some approaches used to deal with increased use are presented below.

Use has been restricted where the demand is judged to exceed supply. An allocation or rationing scheme is used. Typically, an upper limit is set on use (i.e., on the number of people, number of groups or visitor days). Use opportunities are systematically allocated to competing river recreationists. As mentioned, on some western whitewater rivers commercial outfitters and private users compete heavily, so managers must establish use ratios between competing groups. Generally, ratios have been determined either by past use in a given year or are arbitrarily chosen (Elliott 1977). On the Colorado River in Grand Canyon, the current ratio is a 92:8 commercial to private split, the Selway River in Idaho has a 20:80 commercial to private split. Most rivers under the control of the Bureau of Land Management have a 50:50 split (Elliott 1977).

Many rationing mechanisms can be used (Stankey and Baden 1977). Most commonly potential recreationists and commercial outfitters apply for a use permit. From the pool of applicants a predetermined number of permits are issued. For example, managers of the BWCAW established daily entry point quotas for overnight campers by travel zones. The quotas were computer generated using a travel behavior model that predicted the number of people that could be allowed at an entry point without exceeding a predetermined capacity (Peterson 1977). Recreationists are encouraged to apply for a permit before their trip. When a zone reaches capacity no other recreationists are permitted to enter. Instead they must wait another day or until an entry permit becomes available, or select another entry not yet at capacity (Higgins 1977).

Managers sometimes prohibit certain uses to reduce conflicts. When attempts are made to prohibit an activity it often is debated in the political arena and decided by the legislative process. These attempts have had varying degrees of success. In the BWCAW, for example, efforts by conservationists and others were only partly successful in prohibiting motorized craft on waterways, and only after a lengthy legislative process. In Michigan, the Department of Natural Resources sought, among other things, to reduce the number of canoes allowed on the Pine River by 40 to 60 percent. Opposition by local canoe outfitters resulted in a 7-year legal battle over the authority of the State to restrict use (Marek 1979).

Zoning techniques have been used to reduce conflicts among recreationists. On a major portion of the Lower St. Croix River between Minnesota and Wisconsin, "no wake zones" have been established to lessen the conflict between canoes and motorized craft. Horsepower limitation zones have also been used; e.g., 10 horsepower on the majority of motorized routes in the BWCAW.

Time zoning is another way to separate incompatible users. On some trout streams in Michigan fishermen are encouraged to use the river in the early morning and late afternoon hours when canoeing is prohibited. Another popular use of time zoning is the scheduling of trip departure times--from the day down to the hour. On the Chattooga River, for example, commercial outfitters are limited in the number of trips they can make on weekends and are assigned departure times at least an hour apart (Craig 1977).

Informing future visitors about past use in the BWCAW has been successful in reducing congestion and crowding. A brochure pointed out heavily used places so recreationists can avoid crowded areas and peak use periods (Lime and Lucas 1977).

Simulation modeling is a useful tool for managing river recreation use. Lime and his associates (1978) perfected a simulation model to predict patterns of river use occurring under a variety of conditions on the Green and Yampa Rivers in Dinosaur National Monument. The simulation and actual patterns of use were compared to test the simulator's validity and were found to be in close agreement.

To control ecological impacts, limiting party size and assigning campsites are widely used. The assignment of campsites provides an opportunity for vegetation to recover from previous use. On the Middle Fork of the Salmon River in Idaho, trips are scheduled so a particular site is vacant at least 4 of every 10 nights. In the BWCAW only 67 percent of the campsites in a travel zone are expected to be occupied at any one time based on the distribution system now in use. Other techniques used to control ecological impacts include the requirement that recreationists carry fire pans and portable toilets (Mak et al. 1977). In many locales either a ban on cans and bottles or a pack-in - pack-out policy are in force. In the BWCAW, the can and bottle ban has been successful in reducing visual blight. On the Eleven Point River in Missouri, the pack-in - pack-out policy has been reported to be successful (75 to 90 percent of empty cans are removed) (Craig 1977).

Because rivers have common management problems most resource administrators recognize the need for coordinated management among rivers. In response to this need, river managers in the West in 1973, formed the Interagency Whitewater Committee (IWC), composed of representatives from the Forest Service, Bureau of Land Management, Park Service, and Coast Guard. For the most part, the IWC membership is made up of field managers not upper management. The IWC's primary function is to serve as a forum for the exchange of ideas and experiences and to foster a unified interagency approach to river management. The IWC has been instrumental in coordinating western whitewater management activities through the development of the Interagency Management Guidelines (Yearout et al. 1977).

The U. S. Forest Service and the Bureau of Land Management are drafting river recreation management supplements to their manuals. In addition both agencies have conducted fact finding reviews concerning river recreation management activities.

Between the 1960s and late 1970s river recreation management activities grew from largely passive efforts to rigorous innovative activities. But, much management was done by intuition alone. There is now a generation of river managers who have gotten their "feet wet" and who recognize the need for comprehensive and systematic information to assist in the decision process. In fact, the Forest Service and Bureau of Land Management have been given legislative mandates to manage in a more systematic fashion (Lime et al. 1979). As a result, management is now more active and managers are searching for information from research and/or public involvement to establish objectives and solve problems.

FUTURE PERSPECTIVES

In the years ahead the "supply" of river recreation will be threatened by our expanding consumptive needs. Government at all levels, and conservation and other organizations will continue their efforts to identify and protect river recreation resources. But, the intensity of urban and second home development, farming, lumbering, mining, manufacturing, and energy production along rivers will probably reduce recreation opportunities.

Opposition to the administrative designation of rivers for recreation, will increase, especially from local landowners and residents. We suspect that opposition will be based, in part, on people's mistrust and misunderstanding of government intentions in designating rivers for recreation. The cry of "public land grab" will persist and become louder. And, in areas where private land adjoins rivers posting will increase.

Management intervention will increase. In the "near" future, demand for river recreation will continue to increase at a rapid rate. More inexperienced recreationists will be creating safety hazards for themselves and for others. Conflicts among different river recreationists will increase along with increased competition for use of the resource. Some recreationists will probably shift their use to lesser used rivers while others will stop participating altogether. Rationing of use opportunities will become more widespread and will remain controversial and challenged.

Over the long term--20-30 years--demand will level off. The leveling off is expected because the nation's population growth declined markedly in the last decade and will continue to do so. The post World War II "baby-boom" generation makes up the bulk of current river recreationists. As they age and as the effects of a lower birth rate is felt, river managers will be serving a "different" and less rapidly expanding clientele (Marcin and Lime 1977). Future research and management will be oriented towards determining and serving the needs and preferences of the changing clientele.

In the future many management decisions will be decided through the legal and legislative process. Managers will be directed to devise strategies that will insure a spectrum of opportunities. Regional coordination will become more important so that use can be allocated uniformly and efficiently.

Technological innovations will influence demand. Although we will not predict what innovations might occur, some speculation is possible. Technology will assist managers as well as create new problems. Computer technology will be used more widely to aid managers. Technology will also cause management problems by creating equipment that will be capable of performing beyond current expectations.

Energy costs will affect participation in river recreation. People will probably limit their visits to more distant rivers and will probably stay longer. Day trips to rivers closer to home will become more prevalent.

Research will become more important to management. The demands placed on the resource necessitate more systematic evaluation. Pioneer research by academicians and others will assist in setting policy. Also, research by field agencies will increase. Field agency research will monitor the river management to evaluate its success.

REFERENCES

Anderson, Dorothy H., Earl C. Leatherberry, and David W. Lime. 1978. An annotated bibliography on river recreation. USDA For. Serv. Gen. Tech. Rep. NC-41, 62 p.

Aitchison, Stewart W., Steven W. Carothers, and R. Roy Johnson. 1977. Some ecological considerations associated with river recreation management. In River recreation management and research Symp. Proc. USDA For. Serv. Gen. Tech. Rep. NC-28, p. 222-225.

Alling, Curtis E., and Robert B. Ditton. 1979. Obstacles to creation of state river protection systems. J. Soil & Water Conserv. 34(5):229-232.

Bassett, John R., Beverly L. Driver, and Richard M. Schreyer. 1972. User study: characteristics and attitudes on Michigan's AuSable River. Sch. Nat. Resour., Univ. Michigan. 78 p.

Becker, R. H., B. J. Niemann, and W. A. Gates. 1979. Displacement of Users within a river system: social and environmental trade-offs. Paper presented at the Second Conference on Scientific Research in the National Parks, San Francisco, CA., November 26-30.

Boster, Mark A. 1972. Colorado River trips within the Grand Canyon National Park and Monument: a socio-economic analysis. Dep. Hydrol. Water Resour. Rep. 10, Univ. Arizona. 83 p.

Bureau of Outdoor Recreation. 1973. Outdoor recreation: a legacy for America. USDI Bureau of Outdoor Recreation. 89 p. Washington, D. C.

Couch, P. Roy. 1979. Personal Correspondence. Executive Director, National Association of Canoe Liveries and Outfitters.

Countess, Michael L., Walter L. Criley, and B. R. Allison. 1977. Problems and conflicts associated with river recreation programming and management in the East. In River recreation management and research Symp. Proc. USDA For. Serv. Gen. Tech. Rep. NC-28, p. 147-150.

Cox, William E., and Keith A. Argow. 1979. River Recreation: Public Access vs. Riparian Rights. Water Resources Bulletin 15(3):728-739.

Craig, William S. 1977. Reducing impacts from river recreation users. In River recreation management and research Symp. Proc. USDA For. Serv. Gen. Tech. Rep. NC-28, p. 155-162.

Ditton, Robert B., David J. Schmidly, William J. Boeer, and Alan R. Graefe. 1977. A survey and analysis of recreational and livestock impact on the riparian zone of the Rio Grande in Big Bend National Park. In River recreation management and research Symp. Proc. USDA For. Serv. Gen. Tech. Rep. NC-28, p. 256-266.

Doehne, Harry A. 1977. Experiences in managing river recreation, and river use in Michigan. In River recreation management and research Symp. Proc. USDA For. Serv. Gen. Tech. Rep. NC-28, p. 110-116.

Dolan, Robert, Alan Howard, and Arthur Gallenson. 1974. Man's impact on the Colorado River in the Grand Canyon. Am. Sci. 62(4):392-401.

Driver, B. L., and John R. Bassett. 1975. Defining conflicts among river users: a case study of Michigan AuSable River. Naturalist 26(1):19-23.

Elliott, Robert L. 1977. Commercial river outfitting: its educational role and responsibilities to the future. In River recreation management and research Symp. Proc. USDA For. Serv. Gen. Tech. Rep. NC-28, p. 213-219.

Grimm, Gary, and Richard Wyman. 1974. Public rights to rivers. Public wild River Environmental Project, Eugene, Oregon. 21 p.

Grumman Boats. 1975. Rent-a-Canoe Directory. 21 p. Grumman Allied Industries, Marathon, NY.

Grumman Boats. 1978. Rent-a-Canoe Directory. 21 p. Grumman Allied Industries, Marathon, NY.

Hansen, Edward A. 1975. Does canoeing increase stream bank erosion? USDA For. Serv. Res. Note NC-186, 4 p.

Heberlein, Thomas A., and Jerry J. Vaske. 1977. Crowding and visitor conflict on the Bois Brule River. Tech. Rep. WIS--WRC-77-04, 100 p. Univ. Wisconsin.

Hecock, Richard D. 1977. Recreational usage and users of rivers. In River recreation management and research Symp. Proc. USDA For. Serv. Gen. Tech. Rep. NC-28. p. 279-284.

Hendee, John C., William R. Catton, Jr., Larry D. Marlow, and Frank Brockman. 1968. Wilderness users in the Pacific Northwest--their characteristics, values, and management preferences. USDA For. Serv. Res. Pap. PNW-61, 92 p.

Higgins, Joseph H. 1977. A distribution program for the Boundary Waters Canoe Area. Naturalist 28(4):22-29.

Howard, Gordon, John Bethea, Jr., Dee Kiger, and Rebecca Richardson. 1976. Chattooga River visitor survey. 75 p. Dep. Recreation and Park Administration. Coll. For. and Recreation Resour. Clemson Univ.

Jensen, Marvin O. 1979. Information from the social sciences: a critical need of backcountry managers. Paper presented at the Second Conference on Scientific Research in the National Parks, San Francisco, CA., November 26-30.

Klessig, Lowell, and James Hale. 1972. A profile of Wisconsin hunters. Tech. Bull. 60, 24 p. Wisconsin Dept. Nat. Resources.

Knudsen, A. B., R. Johnson, K. Johnson, and N. R. Henderson. 1977. A bacteriological analysis of portable toilet effluent at selected beaches along the Colorado River, Grand Canyon National Park, Arizona. In River recreation management and research Symp. Proc. USDA For. Serv. Gen. Tech. Rep. NC-28, p. 290-295.

Leatherberry, Earl. C. 1979. Minnesota canoe and kayak owners: their characteristics and patterns of use. USDA For. Serv. Res. Pap. NC-171, 8 p.

Lime, David W. 1972. Large groups in the Boundary Waters Canoe Area--their numbers, characteristics, and impact. USDA For. Serv. Res. Note NC-142, 4 p.

Lime, David W. 1977a. Research for river recreation planning and management. In River recreation management and research Symp. Proc. USDA For. Serv. Gen. Tech. Rep. NC-28, p. 202-209.

Lime, David W. 1977b. When the wilderness gets crowded...? Naturalist. 28(4):1-7.

Lime, David W., Dorothy H. Anderson, and Stephen F. McCool. 1978. An application of the simulator to a river recreation setting. In Simulation of Recreational use for Park and Wilderness mangement. Chapter 9, p. 153-174. Resources for the Future, John Hopkins University Press, 220 p.

Lime, David W., Richard C. Knopf, and George L. Peterson. 1979. The national river recreation study: growing new data base with exciting potential. Paper presented at the Second Conference on Scientific Research in the National Park, San Francisco, CA., November 26-30.

Lucas, Robert C. 1964. The recreational capacity of the Quetico-Superior area. USDA For. Serv. Res. Pap. LS-15. 34 p.

Mak, Kenneth R., Marvin O. Jensen, and Thomas L. Hartman. 1977. Management response to growing pressures in western whitewater rivers--the art of the possible. In River recreation management and research Symp. Proc. USDA For. Serv. Gen. Tech. Rep. NC-28, p. 102-109.

Manning, Robert E. 1979. Impacts of recreation on riparian soils and vegetation. Water Resources Bulletin 15(1):30-43.

Marek, Gary. 1979. Environmentalist at large: paddling the Pine to death. Audubon, 81(5):132-144.

Marein, Thomas C., and David W. Lime. 1977. Our changing population structure: what will it mean for future outdoor recreation use? In Outdoor recreation advances in application of economics. USDA For. Serv. Gen. Tech. Rep. WO-2, p. 42-52.

Marnell, L. F., D. Foster, and K. Chilman. 1978. River recreation research at Ozark National Scenic Riverways. National Park Service. 139 p.

Merriam, L. C., Jr., C. K. Smith, D. E. Miller, Ching tiao Huang, J. C. Tappeiner, II, K. Goeckerman, J. A. Bloemendal, and T. M. Costello. 1973. Newly developed campsites in the Boundary Waters Canoe Area. Univ. Minnesota Agric. Exp. Stn., Bull. 511, For. Ser. 14, 27 p.

Merriam, L. C., Jr., and C. K. Smith. 1974. Visitor impact on newly developed campsites in the Boundary Waters Canoe Area. J. For. 72(10):627-630.

Peterson, George L. 1977. The computer takes a canoe trip. Naturalist. 28(4):9-11.

Peterson, G. L., A. Anas, F. S. Kappleman, and P. R. Stapher. 1978. Prediction of urban recreation demand. Final Report, NSF Grant No. Apr.-19086, Northwestern University, Evanston, IL.

Peterson, George L., David W. Lime, and Dorothy H. Anderson. 1979. Attraction of recreationists to rivers: a nationwide view. Paper presented at Second Conference on Scientific Research in the National Parks, San Francisco, CA., November 26-30.

Pfister, Robert E., and Robert E. Frenkel. 1974. Field investigations of river use within the wild river area of the Rogue River, Oregon. Rogue River Study Rep. 1, 108 p. Dep. Geogr., Oregon State Univ.

Pfister, Robert E. 1977. Campsite choice behavior in the river setting: a pilot study on the Rogue River, Oregon. In River recreation management and research Symp. Proc. USDA For. Serv. Gen. Tech. Rep. NC-28, p. 351-358.

President's Council on Recreation and Natural Beauty. 1968. From sea to shining sea: a report on the American environment--our natural heritage. 304 p. Washington, D.C.

Schmidly, David J., Robert B. Ditton, W. J. Boeer, and A. R. Graefe. 1976. Interrelationships among visitor usage, human impact, and the biotic resources of the riparian ecosystem in Big Bend National Park. Paper presented at the First Conference on Scientific Research in the National Parks, New Orleans, LA.

Schmidly, David J., and Robert B. Ditton. 1978. Relating human activities and biological resources in riparian habitats of western Texas. In Proceedings of the Symposium on Strategies for Protection and Management of Floodplain Wetlands and Other Riparian Ecosystems, Callaway Gardens, Georgia. December 11-13, 1978.

Seitz, William K., III. 1974. Patterns of recreational use and characteristics of users on the Upper Iowa River. Ph.D. diss. 193 p. Iowa State Univ.

Settergren, Carl D. 1977. Impacts of river recreation use on streambank soils and vegetation--state-of-the-knowledge. In River recreation management and research Symp. Proc. USDA For. Serv. Gen. Tech. Rep. NC-28, p. 55-59.

Shaffer, Ron E., and Stephen F. McCool. 1973. Who's tubing down the Apple? Tech. Rep. 4, 31 p. Univ. Wisconsin.

Shelby, Bo. 1975. Social-psychological effects of motorized travel in wild areas: the case of river trips in the Grand Canyon. 66 p. Human Ecol. Res. Serv., Inc.

Shelby, Bo. 1979. Politics and research utilization: a case study of river research in Grand Canyon. Paper presented at Second Conference on Scientific Research in the National Parks, San Fransisco, CA, November 26-30.

Shelby, Bo, and Mark Danley. 1979. Allocating river use. 130 p. Oregon State University.

Shreyer, Richard, and Martin L. Nielson. 1978. Westwater and Desolation Canyons: whitewater river recreation study. 196 p. Institute for the Study of Outdoor Recreation and Tourism. Dept. of Forestry and Outdoor Recreation. Utah State University.

Solomon, Michael J., and Edward A. Hansen. 1972. Canoeists suggestions for stream management in the Manistee National Forest of Michigan. USDA For. Serv. Res. Pap. NC-77, 10 p.

Stankey, George. 1973. Visitor perception of wilderness recreation carrying capacity. USDA For. Serv. Res. Pap. INT-142, 62 p.

Stankey, George H., and John Baden. 1977. Rationing wilderness use: methods, problems, and guidelines. USDA For. Serv. Res. Pap. INT-192, 20 p.

State of Minnesota, Office of Hearing Examiners. 1979. Report of the hearing examiner for the Department of Natural Resources on the proposed inclusion of the Cannon River in the Minnesota Wild, Scenic, and Recreational Rivers system. DNR-79-021-AK.

U. S. Dept. of Interior. 1979. Colorado River Management plan. Grand Canyon National Park, Arizona, Final Environmental Statement.

U. S. Dept. of Transportation, Coast Guard. 1974. Recreational boating in the continental United States in 1973: the nationwide boating survey. 104 p. Office of Boating Safety.

U. S. Dept. of Transportation, Coast Guard. 1978. Recreational boating in the continental United States in 1973 and 1976: the nationwide boating survey. 121 p. Office of Boating Safety.

Utter, Jack G. 1979. Wild river recreation management: a case study of the use allocation issue. Ph.D. dissertation. University of Montana, 305 p.

Warren, Sam E. 1977. How to ration river floating use: the Middle Fork of the Salmon experience. In River recreation management and research Symp. Proc. USDA For. Serv. Gen. Tech. Rep. NC-28, p. 151-154.

Water Resources Council. 1968. The nation's water resources. Washington, D. C.

Yearout, Robert, Arthur Seamans, and Larry Lee. 1977. Regional river recreation management. In River recreation management and research Symp. Proc. USDA For. Serv. Gen. Tech. Rep. NC-28, p. 188-192.

CAMPING AND RV TRAVEL TRENDS[1]

Gerald L. Cole and Wilbur F. LaPage[2]

Abstract.--This paper summarizes the results from industry sources and several regional and national camping market surveys conducted between 1960 and 1979. Growth of the industry, together with pricing practices, energy impacts and occupancy data was also examined. By 1978, the number of inactive campers outnumbered active campers nationwide with persons less than 30 showing the greatest tendency to become inactive. Growth of the industry slowed in the 1970's, but franchised campgrounds provided an increased share of sites. A decline in campground occupancy was noted in 1979 and appeared to be correlated with gasoline shortages.

INTRODUCTION

The popularity of camping and RV travel ontinues to grow. According to a 1979 surey, camping now ranks third behind swimming nd bicycling among outdoor recreation activties. The purpose of this paper is to exlore numerous trends, primarily in the 1970's hich have affected the camping market inluding number of active, inactive and potenial campers. We will examine socio-economic haracteristics of the general population and ampers in particular. Trends in changing atterns of camper participation are disussed, including annual days of participation, doption of new activities and new camping ocations. Related to participation changes re the types of equipment used and prefernces for private and public campgrounds. erceptions and images of camping will round ut the recent trends from the standpoint of he camping public.

On the supply side, recent trends in the number of campgrounds and campsites per campground in both the public and private sectors will be examined. Closely associated is the growth in franchising of campgrounds. Trends in camping fees at both private and public campgrounds will be related to facilities offered.

Energy cost and availability will be discussed with respect to camper reaction during the mid or late 1970's.

Finally, occupancy data for 1978 and 1979 will be utilized as an indication of the economic viability of the industry.

THE CAMPING MARKET

Numerous regional and national surveys have been completed since 1960. While direct comparisons are sometimes ruled out by different methodologies, a clear pattern of growth in number of campers and camping households emerges.

The earliest national survey, conducted in 1960 found 3-4 million acting camping households in the U.S. (ORRRC, 1962). The number had increased to six million by 1965. A series of three comprehensive national camping market surveys was conducted in the 1970's (LaPage 1973, Kottke and others 1975, LaPage and Cole 1979).

---

[1] Paper presented at the National Outdoor ecreation Trends Symposium, Durham, NH, April 0-23, 1980.

[2] Gerald L. Cole is a professor of esource economics at the University of elaware, Newark, DE. Wilbur F. LaPage, rincipal recreation scientist with the ortheast Forest Experiment Station, Durham, H.

The first in 1971, found 12.4 million active households; the second in 1973, 14.3 million; and the third in 1978, 17.5 million. While camping participation grew at an average annual rate of 20 percent in the 1960's, growth slowed to less than 8 percent in the early 1970's, and to less than 5 percent in the late 1970's, Table 1.

Growth in total numbers of people was at a somewhat slower rate since average household size declined from 3.33 persons in 1960 to 2.79 in 1979. Three Nielsen surveys (1979) conducted in 1973, 1976 and 1979 support this contention. The number of camping participants increased 7 percent between 1973 and 1976, but the rate declined to 4 percent between 1976 and 1979.

Table 1.--Average annual growth in the numbers of active, inactive, and potential campers, and new households in the United States, during the periods 1971-1973 and 1973-1978, in percent

Market class	Average annual growth	
	1971-1973	1973-1978
Camper:		
Active	+ 7.6	+ 4.5
Temporarily inactive	+ 42.4	+ 9.8
Permanently inactive	+ 14.7	+ 10.4
All campers	+ 14.9	+ 7.2
Noncamper:		
High and medium potential	- 10.4	- 5.2
Low and zero potential	- 2.5	0
All noncampers	- 3.9	- 1.0
New households in United States	+ 2.3	+ 2.4

Source: LaPage and Cole 1979.

The total camping market picture is not complete without looking at the number of inactive campers and potential campers. Nationally, the inactive camper market (former campers) is growing at almost twice the rate of the active segment, Table 2. Between 1971 and 1978 active campers only increased from 19 percent of all households to 23 percent.

In 1971, one-third of all households had at least one adult who had camped; by 1978 the proportion had increased to one-half. Consequently, the pool of "potential campers" - in the high and medium potential category - declined from 12 percent of all households in 1971 to 6 percent in 1978. Growth in the number of active campers is reducing the supply of high potential campers since the active market continues to increase at nearly twice the rate of new household formation in the U.S.

Table 2.--Size of the American camping market in 1971, 1973, and 1978, as a percentage of total households

Market class	1971	1973	1978
Camper:			
Active	19	21	23
Temporarily inactive	5	9	12
Permanently inactive	9	11	15
Noncamper:			
High potential	3	1	1
Medium potential	9	8	5
Low potential	4	17	18
Zero potential	51	33	26

Source: LaPage and Cole 1979.

Camping market growth is not shared among the four major regions in the U.S. in accordance with population distribution, Table 3. Over half of the nation's new campers entering the market between 1973 and 1978 live in the North Central region. Concurrently, there were almost no losses in potential campers or increases in the number of temporarily inactive campers from that region. While the Northeast gained nearly one million campers during the same period, losses to the temporarily inactive category were nearly as great. The pattern in the Western region was similar to that of the Northeast. Meanwhile, the Southern region experienced a net loss in the number of campers even though the largest supply of prospective campers resides there.

An important conclusion may be drawn from the camping market analysis. By 1978, for the first time, the total of permanent dropouts and temporarily inactive campers exceeded the number of active campers. There were two active campers for every inactive in the late 1960's and early 1970's; by 1973-74 the two groups were about equal and today former campers outnumber active campers by over 2 million households.

Characteristics of campers

Demographic characteristics of the population change rather slowly and since camping is a rather broad based participant activity, a similar pattern prevails.

Age. Historically, campers have predominately been persons less than 40 years of

Table 3.--Distribution of active, temporarily inactive, and potential camping households, by region, 1973-1978[a], in millions

Region	Total households		Camping market households					
			Active		Temporarily inactive[b]		Potential[c]	
	1973	1978	1973	1978	1973	1978	1973	1978
Northeast	16.4	17.3	2.3	3.3	1.0	1.8	2.1	1.1
North Central	18.4	20.1	3.2	4.9	2.1	2.2	1.2	1.1
South	21.2	24.2	4.8	4.6	2.0	3.0	2.2	1.9
West	12.3	14.4	4.0	4.7	1.2	2.1	0.6	0.4
United States[d]	68.3	76.0	14.3	17.5	6.1	9.1	6.1	4.5

[a] For an approximate estimate of total persons (campers), multiply 1973 households by 3.01 persons per household, and 1978 households by 2.81.

[b] Temporarily inactive campers have not camped for 3 years or longer. If longer, they said that they had not quit. In 1973 there were an additional 7.5 million permanently inactive households which had increased to 11.4 by 1978.

[c] This includes "high" and "moderate" potential for camping; that is, those who plan to camp or who have a distinct interest in trying it. In 1973 there were an additional 34 million households with little or no interest in camping--by 1978 this figure had not changed significantly.

[d] Northeast: Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania.

North Central: Ohio, Indiana, Illinois, Michigan, Wisconsin, Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska, Kansas.

South: Delaware, Maryland, District of Columbia, Virginia, West Virginia, North Carolina, South Carolina, Georgia, Florida, Kentucky, Tennessee, Alabama, Mississippi, Arkansas, Louisiana, Oklahoma, Texas.

West: Montana, Idaho, Wyoming, Colorado, New Mexico, Arizona, Utah, Nevada, Washington, Oregon, California.

Source: LaPage and Cole 1979.

e reflecting in part the experiences of ung campers, and camping by young families vacation or weekend outings, Table 4. How- er, between 1973 and 1978, a large increase inactivity occurred among heads of house- lds less than 30 years of age. The in- tivity may be temporarily due to formation new households (young children, etc.), but it becomes permanent this will lend to pport the contention made earlier about e increased supply of inactive campers. rthermore, additional survey results in- cate a decline in the participation of ildren under 12 and teens 12-17 between 76 and 1979, -13 percent and -11 percent, spectively (Nielsen 1979). This further lds to underrepresentation of young persons der 30 years of age in the active market d skews the age distribution in favor of ose over 30.

Education, occupation and income. These three demographic characteristics are highly intercorrelated and it is difficult to separate a meaningful cause and effect relationship between one variable and camping participation. Since 1960, some trends have emerged, however. Campers have consistently tended to have higher than median educational levels. For example, A KOA survey (1976) pointed out that 88 percent of camping heads of households have at least a high school education compared to 63 percent of the U.S. public.

Higher than average educational levels among campers transcends into overrepresentation of professional and white collar occupations among active campers. Conversely, in 1978, the largest proportion of potential campers came from the blue collar or semi-skilled categories.

Table 4.--Age distribution for active, temporarily inactive, and potential campers in 1973 and 1978, in percent

Head-of-household's age	United States		Active		Inactive		Potential	
	1973	1978	1973	1978	1973	1978	1973	1978
18-29	27	30	44	41	38	55	42	39
30-39	19	19	25	28	23	15	26	22
40-49	15	14	12	14	15	14	17	20
50-59	15	14	10	9	15	8	8	14
60 or older	24	23	9	8	9	8	7	5

Source: LaPage and Cole 1979.

Finally, the educational levels and occupational groupings for active and inactive campers results in higher than average incomes. In 1976, 44 percent of camping households reported incomes in excess of $15,000, while nationally only 37 percent of households reported incomes in the same category (KOA).

Families vs. singles: Camping has primarily been a family activity and remains so; however, a new trend began to emerge between 1973 and 1978. There was a notable increase in the proportion of single campers and a decline in married campers, with even a more pronounced increase in singles in the temporarily inactive category, (LaPage and Cole 1979).

Changing patterns of participation

Another dimension on the camping market, in addition to the number of participants, is the frequency of participation. Also, a trend analysis of the frequency variable is useful in interpreting total growth of the market. One national survey reports a slight increase in average days of participation from 1973 to 1976, while the rate held steady between 1976 and 1979 (Nielsen 1979). Regionally, a gain was indicated in the North Central states between 1976 and 1979, while the Northeast registered a loss in average days of participation.

In the 1978 Forest Service Survey more active campers said they had recently increased their participation level compared to a decrease or the same level (LaPage and Cole 1979). Average days of participation were 15.98 and very similar to the 1979 Nielsen survey. The 1978 median participation rate was only two weekend trips of three days each. Thus, the heavy half phenomenon reported previously (LaPage 1969) continues to be important. In 1978, one half of the active campers accounted for 78 percent of all camping trips and 77 percent of the total camping days. The 1979 Nielsen survey reported that 32 percent of the active campers participated 20 or more days each year, accounting for 68 percent of total participation.

Travel patterns. The 1976 National Travel Survey indicated that camping trips tend to be longer, in miles, than other trips taken by Americans (U.S. Travel Data Center). In the 1977 NE-100 survey, campers said they were traveling farther from home than in previous years (Bevins and others 1979a). They were seeking new types of experiences or new campgrounds. As of 1977, energy concerns or costs apparently did not deter campers.

Equipment and facility preferences

Tents and recreational vehicles (RV's) were equally preferred in 1971, while in 1973 and 1978 surveys, RV's had gained slightly with motor homes showing the greatest percentage change, Table 5. Tents tend to be the preferred shelter for beginning campers (59 percent in the 1973 study).

RV shipments from manufacturers have been sensitive to general economic conditions and to the energy situation. For example, the gasoline shortage and the recession in early 1974, both likely contributed to a 41 percent decline in shipments compared to the previous year, Table 6. However, shipments regained momentum in late 1974 and the trend continued until 1976, followed by a decline in 1977 and 1978. Truck campers and camping trailers have exhibited a declining market share since 1970, and travel trailers a slight increase. Motor homes have captured the major increase.

Table 5.--Type of shelter used by active campers on last camping trip, 1971, 1973, and 1978, in percent

Shelter[a]	1971	1973	1978
Tent	50	41	42
Camping trailer	13	11	11
Travel trailer	17	17	19
Truck camper	15	15	12
Motor home	3	7	9
Van or converted bus	6	10	10
Pickup cover	6	5	11
Other	-	5	4
Unknown	-	1	1

[a] Totals exceed 100 percent because some campers use more than one type of shelter on a camping trip.

Source: LaPage and Cole 1979.

Table 6. Recreational vehicle shipments, 1970-1978

Year	Camping trailer	Truck camper	Motor home	Travel trailer	Total shipment	Change from preceding year
	- - - -	percent	- - - -		thousands	percent
1970	31	25	8	36	380	- 5.2
1971	21	24	13	42	451	+ 18.7
1972	19	18	20	43	583	+ 29.3
1973	19	17	24	40	529	- 9.3
1974	19	15	23	43	296	- 44.1
1975	14	13	29	44	340	+ 14.9
1976	12	10	35	43	441	+ 29.7
1977	13	8	39	41	414	- 6.1
1978	12	6	40	41	390	- 5.8

Source: LaPage and Cole 1979.

A KOA study (1976) indicates that RV owners camp more nights per year than do tent users. RV users averaged 16 nights per year, tent users 9 nights. Greater convenience and a greater fixed investment may encourage more use of RV equipment.

Little difference in incomes has been reported between tent and RV users; however, a Delaware study concluded that campers earning more than $10,000 per year preferred less campsite development than did those earning more than $10,000 (Brokaw and Cole 1977). The standard level of development included picnic tables, level parking, flush toilets and showers.

Although public campgrounds were used more than private campgrounds in both the 1973 and 1978 studies, the market share for private campgrounds appears to be growing. This trend is likely associated with greater use of RV's since private campgrounds offer a greater opportunity for utility hookups.

Perceptions and images of camping

Americans' perceptions of camping as an outdoor recreation activity were utilized in the 1973 and 1978 national surveys as one means of assessing the market's growth potential. A series of word pairs on a 5-point rating scale ranging from very favorable to very unfavorable were used to develop a composite image. For example, respondents could rate camping as convenient or inconvenient, safe or unsafe, etc. The general public preceived camping to be substantially more favorable than unfavorable, Table 7. Furthermore, there were very few changes in those images between 1973 and 1978.

A major concern was whether perceptions of camping might act as barriers to participation. If potential campers view camping as "difficult" or complex then they may be unlikely to try the activity. In 1973, 50 percent of all prospective campers thought camping would be easy, but by 1978 the percentage had declined to 41 (LaPage and Cole 1979). Also, "comfortable" dropped from 54 percent to 39 percent and "fun" from 57 percent to 42 percent for the same group. Perceptions of crowding increased from 35 percent to 43 percent. The same kinds of perceptual limitations will likely prevent temporarily inactive campers from returning to the active market.

Most importantly, increasingly favorable perceptions among active campers could reflect increased satisfaction and a reduced likelihood of their dropping out of the market. Of the image factors included in the surveys, eight showed higher positive images and four higher negative images in 1978, compared to 1973 (LaPage and Cole 1979). For example, active campers in 1978 felt that camping was less crowded (+10 percent), more convenient (+8 percent), interesting (+5 percent), easier (+3 percent) and more confortable (+3 percent) than in 1973. Conversely, active campers felt it was less safe (-9 percent) and less fun (-5 percent).

Camper's satisfaction with the last camping trip was quite stable between 1973 and 1978, Table 8. The data collected suggest that the accelerating dropout rate is apparently not due to a decline in the quality of the experience. One possible exception may be the availability of utility hookups which may not be keeping pace with the increased use of self-contained units. Also, a minor decline (4 percentage points) was noted among active campers in satisfaction with the level of camping fees. However, reaction to fee levels was more favorable among temporarily inactive campers in 1978, compared to 1973.

The "cost image" of camping is apparently changing for the better among all market segments except potential campers. Among temporarily inactive campers, the belief that camping is a more economical way of traveling and vacationing was much more prevalent in 1978 than in 1973, Table 9. The discrepancy between potential campers and those who have actually camped suggests that an industry sponsored cost comparison could be a source of market growth.

THE CAMPGROUND INDUSTRY - IS IT REACHING MATURITY?

Growth in the private and public sectors

The campground industry was young and exhibited rapid expansion during the 1960's. In the Northeast region, private campgrounds increased 800 percent between 1961 and 1967 and outnumbered public campgrounds by 4 to 1 (Moeller 1971).

Currently, there is no all inclusive inventory of tent and trailer campsites in the U.S. Inventories have been made periodically by the National Association of Conservation Districts - the most recent in 1974. Annually several commercial publishing firms monitor the industry for inclusion of public and private firms in their directories. However, many directories attempt to maintain certain quality standards for the benefit of their clientele. Hence, there is no intent to include all campgrounds. Also, in an industry which has been as dynamic as the campground industry, it is extremely difficult to be aware of all firms entering and exiting.

While there is no agreement on the number of campgrounds and campsites among the various potential sources of information, there is agreement that the industry growth rate has diminished in the late 1960's and during the 1970's. In the Northeast, the growth rate slowed to 12 percent per year between 1967 and 1971 (Bevins and others 1974). This was in part due to a conscious effort by public administrators to reduce the rate of campground expansion.

Two commercial sources indicate that the number of private campgrounds decreased by approximately 10 percent between 1973 and 1978 (Bevins and others 1979b). There is a discrepancy on public sector data; one source indicates a 25 percent increase, another a 27 percent decrease.

Data from Federal resource management agencies indicate a relatively stable supply

Table 7.--Percentage of camping market households with a positive image of camping, 1973-1978

	Camping Market Household											
Image description	All		Active		Temporarily inactive		Permanently inactive		High and medium potential		Low and zero potential	
	1973	1978	1973	1978	1973	1978	1973	1978	1973	1978	1973	1978
Environment:												
Interesting	55[a]	57	86	88	79	77	65	56	83	74	30	34
People friendly	59	59	78	79	66	75	69	59	64	57	47	44
Refreshing	44	47	73	71	70	68	47	41	62	58	21	26
Pleasant	52	57	81	84	73	79	63	59	81	81	27	32
Composite	52	55	80	81	72	75	61	54	72	68	31	34
Conditions:												
Clean	34	34	54	52	39	36	40	30	47	49	21	21
Safe	43	42	64	62	60	53	45	44	45	49	30	27
Uncrowded	25	26	29	34	26	30	36	25	35	26	19	21
Inexpensive	37	37	50	52	44	42	41	37	40	41	28	27
Composite	35	35	49	50	42	40	40	34	42	41	24	24
Attraction:												
Easy	35	35	56	62	47	40	36	37	50	41	21	18
Fun	40	39	62	57	56	46	45	45	57	42	23	25
Convenient	27	32	47	53	40	39	31	36	35	37	15	16
Comfortable	39	39	65	67	56	49	43	43	54	39	20	20
Composite	35	36	58	60	50	44	39	40	49	40	20	20
Number of respondents	2,199	2,013	450	423	214	238	281	318	198	109	1,056	908

[a] In 1973, 55 percent of the U.S. public felt that camping was interesting; that is, they assigned a 1 or 2 on a scale of 1 to 5 (1 being the most positive, 5 being the most negative).

Source: LaPage and Cole 1979.

situation in Forest Service and Park Service campgrounds and a modest increase at Corps of Engineer operated facilities during the 1979's (Bevins and others 1979b).

Utilizing the various sources of information, it appears that in 1978 we had approximately 7,000 public campgrounds and 9,000 privately operated enterprises.

It is also important to look at the trend in numbers of campsites. One source indicates an annual 20 percent increase nationally in the number of private sites between 1967 and 1973, and a 12 percent increase in public campsites (Bevins and others 1979b). Growth slowed between 1973 and 1978 to a five percent increase in the private sector and less than one percent increase in the public sector, Figure 1.

The trend is towards larger campgrounds. Private campgrounds averaged 88 sites in 1978, compared to only 28 sites in 1967, a 214 percent increase, Figure 2. In a Northeast regional study, private campgrounds averaging fewer than 50 sites were much less likely to be financially successful than larger units (Bevins and others 1974). Public campgrounds exhibit a similar

Table 8.--Camper satisfaction or dissatisfaction with last camping trip, 1973, and 1978, in percent

Degree of satisfaction[a]	Active		Temporarily inactive		Permanently inactive	
	1973	1978	1973	1978	1973	1978
Overall trip:						
Generally satisfied	93	93	89	91	73	78
Generally dissatisfied	4	5	8	8	16	14
Does not apply to my camping style	2	1	2	1	6	4
Campsite availability:						
Generally satisfied	78	78	75	83	63	71
Generally dissatisfied	9	11	12	9	13	15
Does not apply to my camping style	12	10	11	8	18	9
Hookup availability:						
Generally satisfied	53	48	54	54	39	52
Generally dissatisfied	5	8	7	8	7	9
Does not apply to my camping style	38	43	33	33	40	36
Recreation facilities:						
Generally satisfied	73	72	71	72	55	66
Generally dissatisfied	11	11	12	14	14	15
Does not apply to my camping style	15	15	15	13	24	13
Cleanliness and condition of campground:						
Generally satisfied	78	80	76	76	65	72
Generally dissatisfied	12	9	13	13	15	13
Does not apply to my camping style	9	11	9	8	15	10
Level of camping fees:						
Generally satisfied	70	66	70	75	54	65
Generally dissatisfied	9	11	8	6	5	8
Does not apply to my camping style	17	20	16	13	25	16

[a] Totals do not equal 100 percent in most cases because of nonresponses.

Source: LaPage and Cole 1979.

Table 9.--Attitude toward the total cost[a] of camping compared with other ways of traveling and taking a vacation, 1973 and 1978, in percent[b]

Camping group	More economical		Less economical	
	1973	1978	1973	1978
U.S. public	43	46[b]	14	14[b]
Active	66	67	13	13
Temporarily inactive	51	72	18	9
Permanently inactive	45	49	18	19
High-potential households	51	40	15	5
Medium-potential households	53	47	9	13
Low-potential households	36	32	16	15
Zero-potential households	27	24	11	16

[a] Respondents were asked to visualize the total cost of camping as including taxes on equipment, campsite fees, extra tolls, insurance, and other equipment costs.

[b] Totals for each year do not equal 100 percent due to many respondents reporting "no opinion."

Source: LaPage and Cole 1979.

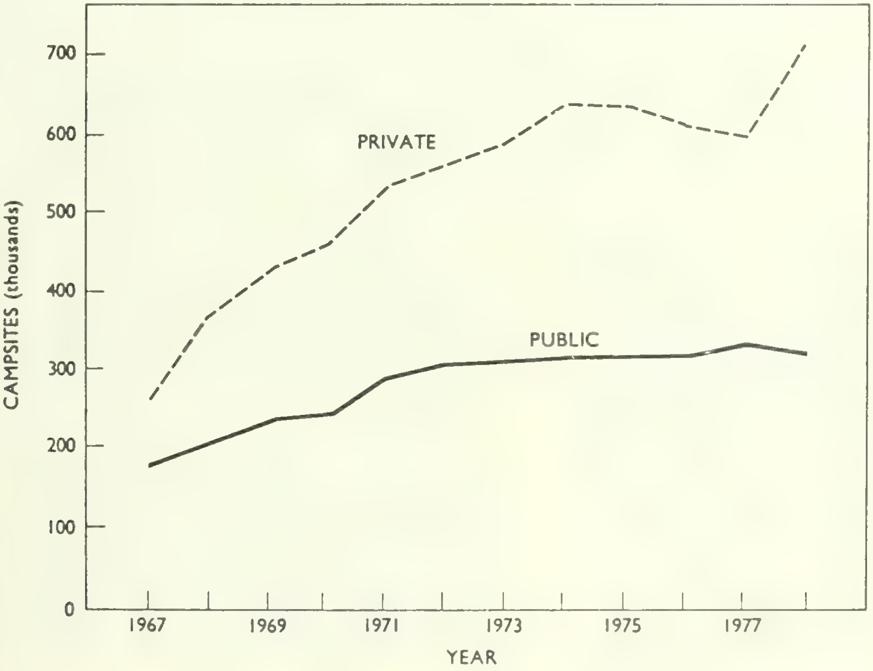


Figure 1.--Public and private developed campsites in the United States. Woodall management has indicated that 1977 private campsite numbers may be low because of changes in campground inventory procedures and not because there were fewer private campgrounds.

Source: Bevins and others 1979b.

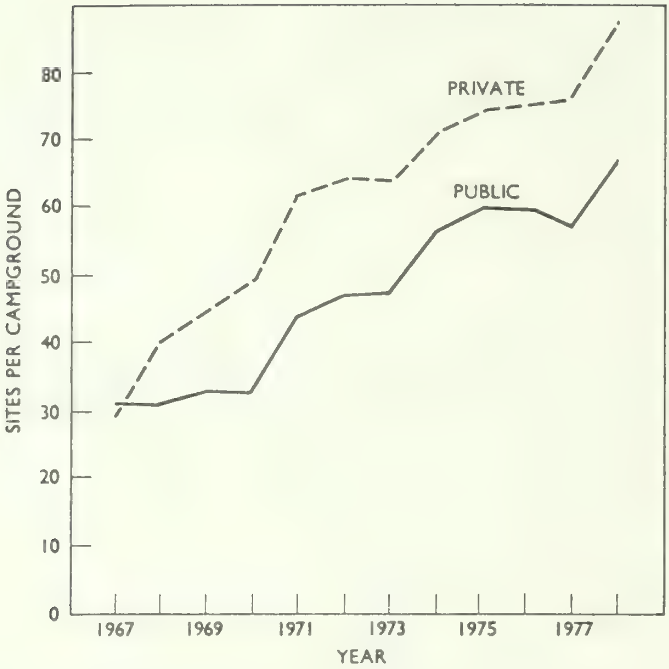


Figure 2.--Average number of campsites per campground listed by Woodall Publishing Co., 1967-1978.

Source: Bevins and others 1979b.

trend, more than doubling from 31 sites in 1967 to 67 in 1978 (Bevins and others 1979b).

Private campgrounds have grown out of economic necessity and in some areas due to zoning regulations that prevented establishment of new campgrounds but allowed existing businesses to expand. Growth has not occurred uniformly throughout the U.S. There was over twice the resident population per campsite (333) in the Northeast region compared to the Western region (154) in 1977 (Bevins and others 1979b). This ignores interregional travel among campers, but illustrates the disparity in available sites especially if energy concerns increase.

Growth in the private sector was likely stimulated by an additional trend which emerged during the 1970's - franchising. While the number of franchisers decreased from 27 in 1970 to 6 in 1977, franchised campgrounds grew to occupy an impressive market share (Oertle 1977). The 1976 Woodall's Campground Directory indicated that 12.1 percent of the private campgrounds were franchisees, providing 21 percent of the available private campsites. By comparison, this was over four times as many spaces as provided by the National Park Service and National Recreation Areas combined.

The franchisers stressed a package of services and amenities that couldn't be found in the public sector and that would appeal to the destination type camper. Included in the service package by some of the chains was a nationwide reservations service similar to that provided by motel chains.

Pricing practices

Fee structures in the private and public sectors are not always based on the same management goals. Traditionally, public agency managers have adopted the philosophy that public campgrounds should be only partially supported from rental fees.

Recent studies in Oregon, Pennsylvania and Rhode Island suggest that costs per site per night exceed fees charged by up to $12.00 (LaPage 1978). A few states, notably New Hampshire, have directed state park managers to adjust fees upward to recover full costs of development and operation. This is the exception, however. A Northeast study found that between 1960 and 1971 state park fees barely kept pace with increases in the prive level, with no allowance for increased development costs (Bond and others 1973).

Private campground owners have often criticized the public agencies as a source of unfair competition when less than full cost fees are charged. However, it appears that the private sector has attempted to carve out a segment of the market not being served by public campgrounds, and adjusted their fees accordingly. By 1977, more than three-fourths of all sites at private campgrounds had electricity and water, while only one-fourth of public sites had electricity and only one-tenth had water (Bevins and others 1979b).

An analysis of fees in the Northeastern states indicated that trailer site fees at private campgrounds were 43 percent higher than public fees for similar sites in 1977 (Bevins and others 1979b). The basic fee was $4.60 at private campgrounds, compared to $3.22 at public campgrounds. Both the private and public sectors increased fees between 1973 and 1977 with a slightly greater increase in the private sector (30 percent) compared to the public sector (27 percent). Fee increases varied considerably among states in the region. There was no increase at Connecticut's public campgrounds but a 95 percent increase occurred in New Jersey. Private fee increases ranged from 25 percent in Vermont to 40 percent in New Jersey. The variation in trends noted suggests that numerous forces were at work, including differing public policies concerning fees and variations in willingness to pay among campers. The highest fees were recorded in Delaware and New Jersey, two states near to major population centers with camping available to ocean beaches.

Willingness to pay studies have indicated that campers supported higher fees in both public and private campgrounds, although acceptable increases in private campgrounds were approximately half the level at public campgrounds (Bevins and others 1979b). This probably reflected the higher fees already being charged at private campgrounds.

Energy and economic conditions

The two Forest Service national surveys, conducted in 1973 and 1978, both attempted to learn of the impact of the gasoline situation and/or economic conditions on camping trips. Gasoline availability or cost, together with the total anticipated trip cost, were insignificant reasons given for either cancelling or shortening a planned camping trip. While shipments of recreational vehicles cited earlier appear to be sensitive to economic conditions, the above results do not suggest that camping participation has been affected.

Participation in relation to industry capacity based on occupancy data

One of the key indicators of the economic health of the hotel-motel industry is percent occupancy. Similar statistics should be beneficial to the campground industry. For the first time, in 1978, the National Campground Owners' Association coordinated a nationwide effort to monitor weekly occupancy data from a sample of campgrounds. The effort was successful and was expanded from 94 campgrounds in 1978 to include 259 in 1979. Consequently, two years of data are available for the period from Memorial Day to Labor Day.

Nationally, average daily occupancy declined from 58 percent for the 1978 season to 47 percent in 1979, representing a 19 percent loss in business (LaPage and Cormier 1979). While in prior studies campers said they had not curtailed trips because of gasoline cost or availability, it appears that they were influenced in 1979. The decline in occupancy was greatest in the Western region. Seasonal 1979 slumps appeared to coincide with the appearance of gasoline shortages in California. Likewise a decline in occupancy in other regions appeared to be correlated with gasoline availability.

Occupancy levels for both years were highest in the Northeast, followed closely by the Western regions. Levels were significantly lower in the North Central and Southern regions. Because of greater driving distances in the West, there was a smaller proportion of weekend only camping or less variation between weekday and weekend occupancy rates. In the Northeast, the smallest of the four regions, higher occupancy rates overall and weekend peaking reflect lesser distances from population centers to tourist attractions. Also, during 1979, seasonal rentals were up in all regions except the West.

While two years of data are insufficient to establish a trend, nationwide a 14 percent decline in occupancy between 1978 and 1979 was noted. Continued monitoring will be useful to evaluate the impact of energy and economic considerations.

SUMMARY AND CONCLUSIONS

Several national and regional market surveys and industry sources were utilized to establish trends in camper participation, characteristics of campers, attitudes about camping, travel patterns and equipment preferences. Growth of the industry, both in terms of campgrounds and the number of campsites, was also examined together with pricing practices, energy impacts and occupancy data.

By 1978, the number of inactive campers nationwide outnumbered active campers. Persons from 27 percent of U.S. households had tried camping and dropped it. Furthermore, there are fewer potential campers as viewed by the public's image of camping. Younger persons (less than 30) have become inactive in a greater proportion than other age groups in the population.

Camping still retains a favorable cost image as an economical means of traveling and vacationing among active and inactive campers, but to a lesser degree among potential campers. This may indicate a need for an industry sponsored cost comparison campaign to educate potentials.

Camper satisfaction with the last camping trip remained quite stable in the 1970's. A minor decline was noted in satisfaction with fee levels.

A noticeable slowdown in the rate of campground growth occurred during the 1970's. By the end of the decade, there were indications that the number of campgrounds could even be declining. However, it was apparent that the number of campsites continued to increase, reflecting expansion of existing campgrounds into more economically sized units. The number of campsites relative to population remained smallest in the Northeast region and largest in the Western region of the U.S. By 1976, franchised campgrounds provided over 20 percent of private sector sites.

Fees charged in the public sector often represented a management philosophy of recovery of less than full costs. Fee increases were greater in the private sector during the 1970's, perhaps out of economic necessity. Private campgrounds provided a greater share of utility hookups than the public sector.

Prior to 1979, there was no indication that energy availability or prices had been a deterrent to campers' planned trips. However, occupancy data for 1979 compared to 1978 clearly indicate a decline nationwide among a sample of reporting campgrounds. Declines in occupancy appear to be correlated with regional gasoline shortages. Occupancy levels were highest in the Northeast for both years and lower in the Southern and North Central regions. There was more weekend peaking in the Northeast, reflecting shorter driving distances and the least amount in the West because of greater distances. The question of energy prices and availability looms as a major challenge to the industry in the 1980's, particularly in view of a decline in the growth rate of the camping market.

LITERATURE CITED

Bevins, Malcolm I., Tommy L. Brown, Gerald L. Cole, Kenneth J. Hock and Wilbur F. LaPage. 1974. Analysis of the campground market in the Northeast. Report II. Privately owned areas. Vermont Agric. Exp. Stn. Bull. 679.

Bevins, Malcolm I., Tommy L. Brown, Gerald L. Cole, Kenneth J. Hock, Marvin W. Kottke, Wilbur F. LaPage, Richard W. Stammer and Daniel J. Stynes. 1979a. Changing patterns of outdoor recreation participation in the Northeast. Delaware Agric. Exp. Stn. Bull. 427.

Bevins, Malcolm I., Wilbur F. LaPage and Daniel P. Wilcox. 1979b. The campground industry: Recent national trends. USDA For. Serv. Gen. Tech. Rep. NE-53.

Bond, Robert S., Malcolm I. Bevins, Tommy L. Brown and Paul R. Fiske. 1973. Analysis of the campground market in the Northeast. Report 1, Public policy. Massachusetts Agric. Exp. Stn. Bull. 601.

Brokaw, Marion J and Gerald L. Cole. 1977. An economic analysis of camper equipment preferences, facilities and fees in relation to income. Delaware Agric. Exp. Stn. Bull. 422.

Kampgrounds of America. 1976. 1976 camper survey. Billings, Mont.

Kottke, Marvin W., Malcolm I. Bevins, Gerald L. Cole, Kenneth J. Hock and Wilbur F. LaPage. 1975. Analysis of the campground market in the Northeast. Report III. A perspective on the camping involvement cycle. USDA For. Ser. Res. Pap. NE-322.

LaPage, Wilbur F. 1969. Campground marketing: The heavy half strategy. USDA For. Ser. Note NE-93.

LaPage, Wilbur F. 1973. Growth potential of the family camping market. USDA For. Ser. Res. Pap. NE-252.

LaPage, Wilbur F. 1978. The camping market and the campground industry: trends and research. In Campgrounds and camping 1980 conference proceedings, Southern Illinois Univ., Carbondale.

LaPage, Wilbur F. and Gerald L. Cole, 1979. 1978 national camping market survey. USDA For. Ser. Res. Pap. NE-450.

LaPage, Wilbur F. and Paula L. Cormier. 1979. The national campground occupancy index. A report to the Board of Directors, National Campground Owners Assoc. USDA For. Ser. unnumbered report.

Moeller, George H. 1971. Growth of the camping market in the Northeast. USDA For. Ser. Res. Pap. NE-202.

Nielsen, A. C., Company. 1979. Sports participation study. Camping.

Oertle, V. Lee. 1977. The franchising phenomenon. In Woodall's trailer and RV travel. Woodall Publishing Co., Highland Park, Ill.

Outdoor Recreation Resources Review Commission. 1962. National recreation survey. Study report 19, U.S. Gov. Print. Off., Washington, D.C., p. 31.

U. S. Travel Data Center. 1977. 1976 National travel survey: full year report. Washington, D. C.

TRENDS IN THE MARKET FOR PRIVATELY OWNED SEASONAL RECREATIONAL HOUSING[1]

Richard L. Ragatz,[2] Ph.D.

Abstract. The market for privately owned seasonal recreational properties, such as vacation homes, recreational lots, and resort condominiums has encountered many peaks and declines during the past 15 years. While demand for traditional types of recreational property has recently fallen off due to inflation and lack of financing, other alternatives such as resort timesharing are again beginning to stimulate the market.

INTRODUCTION

Since the late 1960's this nation has encountered a great proliferation in the supply of and demand for privately owned property for seasonal-recreational purposes. Included in this market are the three traditional commodities of vacant recreational lots, single family detached vacation homes, and resort condominiums and more recent innovative commodities such as timeshare units, lots sold as camping and recreational vehicle sites, and undivided interests.

While the market has gone through a series of peaks and declines in the 1970's, recent events indicate interest is being created anew by both producers and consumers. New products are being created and it appears the market will continue to be part of the lifestyle of many Americans.

It is estimated that somewhere between 12 and 15 million recreational lots and about 3.5 million vacation homes currently exist in this country. The market for vacation homes is oriented toward a user product as owners purchase these secondary shelters to enjoy during weekends and vacation periods throughout the year. The larger market for recreational lots is more complex in nature, being created by two major causal factors. The first relates to those persons who buy such lots for the immediate or future siting of a vacation home. The second relates to those persons who buy such lots for speculative purposes in the hopes of realizing equity appreciation on their invested capital.

TRENDS IN MARKET FOR RECREATIONAL PROPERTIES

Early History

In order to set the market for seasonal-recreational properties in proper perspective, it is useful to back up and describe how this phenomenon has evolved in recent years.

Seasonal occupancy of land and housing can be traced through the history of the United States. During the early colonial period, the land-holding aristocracy in the South frequently maintained their primary residence on the plantation, but owned second and third homes in other communities or areas that provided recreational amenities. This multiple home ownership pattern existed in the Northern states, where wealthy families are known to have owned additional homes for recreation before the Revolutionary War (Fenton 1965).

During the late 19th and early 20th centuries, peaks in vacation home ownership corresponded with periods of affluence and improvements in transportation. Such occupancy patterns influenced the development of traditional recreational areas such as Newport Beach, Palm Beach, the Adirondack Mountains, and the mountains of North and South Carolina and Virginia.

---

[1] Paper presented at the National Outdoor Recreation Trends Symposium, Durham NH, April 20-23, 1980.

[2] Richard L. Ragatz is President, Richard L. Ragatz Associates, Inc., Consultants in Vacation Housing and Recreational Communities and Professor of Urban and Regional Planning, University of Oregon, Eugene, Oregon.

Many factors have contributed to a tremendous expansion of the market for recreational properties during the past 2 decades. Although popular for generations, lack of both publicity and low-cost production methods seemed to maintain the traditional association between this type of property and affluence. Few marketing programs were directed at middle-income families until the early 1960's.

Historically, there have been 2 basic types of recreational land development occurring in this country. One was simply the scattered lot found in a rather secluded area not too far from a city. Favorite spots were around lakes, in mountains, and on the seashore. Typically purchase of the lot was made from an individual farmer or rancher who was selling off marginally productive or nonproductive land. Lots were usually small, density frequently high, with very few if any, public facilities being provided. Houses constructed on these lots often were small and usually were not built for permanent living quarters, e.g., the hunting cabin in the Maine woods or the lake cottage in the Adirondacks. Scattered lot development is still occurring today, but the mass market has shifted to a more organized type of sales promotion and land development.

A second type of historical development was a series of platted lots in scenically attractive areas. Again, lots were small (usually at urban densities) and public facilities and services were minimal. For the most part, locations were close to existing metropolitan areas in an attempt to tap the mass market. Many of these areas have evolved to the point where, today, they are communities of primary residences. Typical examples are found on Cape Cod, the Jersey Shore, and St. Petersburg, Florida.

Recreational land projects

During the late 1950's and early 1960's mass merchandising of recreational land began. As noted by one researcher (Burlingame 1973):

> Developers found that they could sell land by direct mail like soap. All that was required was to tie up the land by the purchase of options, make some minimal improvements, hire a sales force, launch an advertising campaign, and start selling. Many developers got rich on down payments alone. At first developers were selling retirement lots; later they switched from a retirement to an investment pitch, and the real abuses began. By 1970, this land merchandising business had become a gigantic industry selling between four and five million dollars worth of lots annually.

Probably nothing harmed the land development industry and created as negative an image in the public's eye as did these land merchandising projects. Land was prematurely subdivided, few amenities or services were provided, promises often were broken, consumers have been frequently dissatisfied, and buildout has remained extremely low.

The vacation home "subdivision" began to occur in the mid-1960's and has been described as follows (Burlingame 1973):

> Here, land is marketed more toward a user market within a certain distance of metropolitan areas. Often some recreational amenities were built such as man-made lakes, swimming pools, golf courses, etc. The general philosophy of developers was to construct the beginnings of a real community by making general site improvements, constructing some housing, and providing some developed recreational amenities. However, the business was still one of merchandising land. Every major metropolitan area in the United States has at least a few and often as many as 20 or more second-home communities nearby. This market was essentially a user market aimed at people who actually intended to use the property for leisure time pursuits, as opposed to those interested merely in speculative land investment.

The vacation home subdivision has a great range of quality as a large number of both good and poor projects exist throughout the country.

Recreational communities

A development frequently referred to as a recreational "community" began to occur in the late 1960's as is described as (Burlingame 1973):

> While developers are still making most of their money off of land sales, their time frame is greatly extended (5 to 20 years) and their plans for extensive development often include the construction of housing. The market is predominantly a user market of home buyers, rather than lot boyers. These developments are high amenity projects with developed recreational facilities such as golf courses, marinas, ski

> slopes, and so on. Front end investments in recreational amenities and site improvements are high, and the companies either building or financing such projects are generally large corporate enterprises.
>
> The market group is high income and often can afford to fly into their project from some considerable distance rather than get to their property via auto. Speculative investment still occurs, although often in housing rather than just land alone. These projects exhibit the greatest likelihood of financial success in terms of establishing a lasting and viable community or real worth.

Usually limited only to the very affluent consumer, community-type projects are fairly complete in almost every public service and facility aspect, in addition to offering a wide variety of recreational amenities. Many are advertised as "new towns," and while usually high in quality, they frequently still do not have the complete infrastructure associated with a well developed urban environment.

Resort condominiums

Resort condominiums started to become popular in the late 1960's. When compared with total acres devoted to recreational land use and the total number of vacation home units, the resort condominium market is still relatively small. However, in many parts of the country, (e.g., Lake Tahoe, the Florida coast, the Caribbean, and Hawaii) they have become extremely popular. For the most part, resort condominiums are found as part of a vacation home community-type of development, along with single-family detached vacation homes and individually owned recreational lots, though some have developed apart from these areas.

Timesharing

Other opportunities in recreational land also have become available to the consumer in the past few years including properties of shared ownership. It now is possible to buy a portion of a recreational shelter rather than the entire unit. Called "timesharing," this concept allows purchases to be made not only for units of space but also for units of time. Thus, a consumer can pay 1/52 of the total selling price of a condominium unit and be entitled to its use for 1 week of the year. This approach opens up the market to more persons of course since entry cost is considerably lower than for other types of recreational real estate.

The timeshare concept is described in more detail as follows (American Land Development Association 1978):

> Timesharing is a way for you to use or own resort accommodations when you want them, and forget about them when you don't. The term "timesharing" is pure American -- borrowed from the computer industry; but the concept is European -- and more than a decade old.
>
> Thousands of Frenchmen, Germans, Italians, and Englishmen vacation in their places in the Alps, or along the Mediterranean coast for a week, two weeks, or more each year, then return home comfortable in the knowledge that when they come again next time, their condominiums, hotel units or villas will be clean, well cared for and ready for them to move into. Each owns the right to exclusive use of anything from 300 square foot efficiency apartment to a luxury villa for a certain period of time each year, for anywhere from 20 to 50 years.
>
> In the early 1970's, two things combined to open the gates in the United States to this European immigrant timesharing. Condominiums for sale at major resort areas threatened to become so expensive as to preclude purchase by any except the well heeled; Americans began to realize that one did not have to own a condominium or other lodging to be able to depend on having it available to use when they wanted it -- just what the Europeans, who had long been limited in their real estate purchases by scarcity and high cost, had known for years.
>
> In this realization lies the central element of the resort timeshare: it is a means for the guaranteed use of resort accommodations and facilities and not an investment in real estate.
>
> Types of timesharing fall into two broad categories:
>
> > Where you may buy an ownership interest in real estate (the building and common area)
> >
> > Where you may buy a right to

use the living space for a specified number of years but you do not have an ownership interest in real estate

As a timeshare owner, you would generally be free to sublease or allow friends or family to use your timeshare in your absence. Or you can trade use informally, or formally through trading networks or exchange programs.

Exchange programs are attractive for many reasons. Especially popular are the external exchange services, which offer maximum flexibility, and variety of choices, plus the help of an operating service in making arrangements.

As part of an exchange program, without selling your timeshare, you may spend time in various kinds of resorts from the seashore to the mountains to foreign countries. You could, conceivably, go to a new place each year.

Undivided interest

Another recent concept being employed in the recreational property industry is undivided interest which refers to a system of conveying usufructuary rights wherein all members share equally in the use and ownership of the entire property.

Closely related to timesharing, the use of undivided interest as a means of dividing property on a share-and-share-alike basis is not a new phenomenon. It has been utilized in intentional communities, collective agriculture endeavors, hunting and ski groups, and as a common basis for partnership arrangements. What is new, however, is the application of this form of ownership to the development and marketing of large-scale recreation properties. Unfortunately, the newness and uniqueness of the concept makes it practically impossible to undertake a productive analysis of the state-of-the-art. Several undivided interest projects directed to the RV camper were initiated in the early 1970's. For the most part they were unsuccessful due to an economic recession, gasoline shortage, and probably the newness of the concept. During the past two years, several such projects have been attempted with varying degrees of success.

The main difference between timesharing and undivided interest is that in the latter alternative, the buyer has unlimited access to the recreational property (whether it be actual shelter or a campsite) while the former alternative only allows access during a specific time period. Also, undivided interest always gives the consumer shared ownership of the whole (land and improvements) while the opportunity of ownership may or may not be applied to timesharing.

An example of a recent undivided interest project is being implemented in Idaho. Here, 500 buyers will share equally in the ownership of a 4,000 acre ranch, cattle, an extensive set of recreational amenities, and 40 cluster housing units. For $40,000 apiece they receive 1/500 ownership in addition to unlimited access to the housing units throughout the year, on a first-come-first-served basis.

Summary of market trends

As indicated by the wide variety of products brought onto the recreational land market in the late 1960's and early 1970's, it once appeared that the demand for such items was almost insatiable. Between 1967 and 1973, millions of properties were created and purchased.

However, in late 1973 the market for recreational properties encountered a plethora of problems and went into a severe downturn for several years. Causes included such items as extensive negative publicity about consumer ripoff, a national economic recession and the tightening of financial resources, the energy crisis, environmental concerns, and a mass of new public regulations imposed upon the private land development process.

During about the middle of 1976, the market began to again become more active due to:

1. more discretionary income;
2. more faith on the part of the buyer that the many new consumer and environmental regulations assured a safer and more usable product;
3. availability of additional alternatives such as timesharing and undivided interest; and
4. traditional motivational factors such as status, familism, desire to participate in outdoor recreation, desire for ownership of real property, the frontier fantasy with open space and scenic areas, desire to escape urban disamenities, opportunity for equity appreciation, and a variety of other reasons.

While demand for privately owned recreational properties (especially vacant lots) may never again reach comparable proportions as during the 1967 to 1973 period, the market will most certainly always exist in this country to some degree.

MAGNITUDE AND LOCATION OF EXISTING RECREATIONAL PROPERTIES

Recreational lots

Reliable figures for the number of recreational properties are not available. Fragmented estimates are found in several sources, however, and can be used to provide some approximate base figures.

Since 1968, all recreational land projects in the United States containing more than 50 lots and that are advertised outside of the state in which they are located, have to be registered with the Office of Interstate Land Sales Registration (OILSR), in the U.S. Department of Housing and Urban Development.

In reviewing the OILSR data, it is found that almost 5 million lots were registered in 4,388 projects during the 10 years from 1968 to June 1977. Contained in these projects are about 4.4 million acres of subdivided land. Table 1 shows the location of these registered projects on a state-by-state basis.

Table 1.--Distribution of Projects, Acres, and Lots Registered With OILSR, By State, 1968 to 1977

State	Projects	Acres	Lots
United States	4,388	4,363,620	4,862,478
Alabama	28	12,812	14,601
Alaska	11	2,789	2,494
Arizona	443	464,745	392,336
Arkansas	72	90,270	149,451
California	399	415,130	287,652
Colorado	256	399,679	190,929
Connecticut	5	2,747	2,079
Delaware	34	3,067	7,340
Florida	665	1,426,065	1,716,898
Georgia	59	30,862	32,859
Idaho	47	10,175	9,192
Illinois	31	22,657	37,325
Hawaii	57	26,668	27,552
Indiana	45	16,741	32,515
Iowa	20	8,429	12,357
Kansas	18	7,434	16,238
Kentucky	65	11,493	23,680
Louisiana	19	10,451	11,811
Maine	27	10,827	10,814
Maryland	40	12,992	23,680
Massachusetts	30	8,249	11,363
Michigan	86	41,341	51,090
Minnesota	17	9,634	11,978
Mississippi	55	28,372	52,067
Missouri	111	33,204	63,025
Montana	22	5,896	3,726
Nebraska	7	2,693	7,218
Nevada	39	70,527	45,339
New Hampshire	53	14,756	10,784
New Jersey	16	5,295	12,031
New Mexico	94	390,108	422,477
New York	17	9,150	17,321
North Carolina	153	69,409	87,301
Ohio	40	15,652	39,359
Oklahoma	13	3,983	8,603
Oregon	79	50,639	23,676
Pennsylvania	166	113,135	157,680
South Carolina	44	18,646	20,855
South Dakota	3	167	198
Tennessee	63	30,956	59,701
Texas	510	269,679	531,465
Utah	72	32,031	28,329
Vermont	26	12,250	8,319
Virginia	111	61,871	93,072
Washington	117	41,824	51,924
West Virginia	23	4,957	15,788
Wisconsin	64	29,806	23,284
Wyoming	16	3,357	3,070

Source: U.S. Department of Housing and Urban Development, Office of Interstate Land Sales Registration, Washington, D.C. Unpublished material obtained from the office.

It is found that a very significant concentration of projects occurs in a small number of states. Almost 1/2 (46.1 percent) of the 4,388 projects are located in only 4 states (Florida, Texas, Arizona, and California). Over 1/4 (26.8 percent) are located in Florida and Texas alone.

Table 1 also provides information on the distribution of lots and acres in these projects. The 6 states of Florida, New Mexico, Arizona, Texas, Colorado, and California contain 77.2 percent of all the acres and 73.1 percent of all the lots. In absolute figures, we find that in these 6 states alone, about 3.3 million acres and 3.5 million lots have been subdivided in the past 10 years for recreational use.

When analyzing the location of recreational land projects registered with OILSR on a county-by-county basis, it is found that 1,310 counties have such projects. This represents about 1/3 of all the counties (3,115) in the United States.

Some 682 counties contain either: (1) 5 or more recreational land projects registered with OILSR; (2) 1,000 or more lots in such projects; and/or (3) 1,000 or more acres in such projects. Most noticeable locations for recreational subdivision activity are counties either: (1) along the major coast lines

(Pacific, Atlantic, Gulf, and Great Lakes); (2) in mountain ranges (Poconos, Ozarks, Rockies, Cascades, and Sierras); (3) throughout the southwestern states of Colorado, Utah, New Mexico, Arizona, and Texas; (4) in traditional recreation-oriented states such as Florida, Vermont, New Hampshire, California, etc.; and (5) surrounding major metropolitan areas and containing some type of natural recreational amenity.

While the preceding discussion indicates that recreational land development was very rampant between 1968 and 1977 as measured by the large number of projects filed with OILSR, it is estimated that perhaps only 2/3 of all recreational land subdivisions in the country actually have been registered. If these non-registered projects were included, the totals would probably be closer to 6,000 projects, 7.5 million lots, and 6 million acres.

It also is known that only a portion of all recreational lots are found in subdivided recreational land projects. Many more are found as scattered lots sold off by individual land owners during the past many decades.

A national opinion survey by Opinion Research Corporation of Princeton, New Jersey, found that 8.5 percent of all households in 1973 owned a recreational lot. In absolute terms, this represents some 5.4 million lots. It is impossible to accurately estimate the total number of both sold and unsold recreational lots. However, some surveys indicate that only between 1/3 and 1/2 of all subdivided recreational lots have been sold. If this is true, it would mean that somewhere between 12 and 15 million recreational lots currently exist in this country, which is probably a conservative estimate.

Vacation homes

For vacation homes, the most reliable figures on existing stock are available from the 1970 United States Census of Housing. Frequent estimates have been made by other researchers, but they represent only fragmentary, educated guesses. Unfortunately, not even the Census has provided a well-defined count of vacation homes.

Within the vast array of information from the Census are 2 sets of data that relate directly to vacation housing. The first set is concerned with the vacation homes themselves.[1] The second set is concerned with the number of households which own vacation homes.[2] Thus, the second set of data shows numbers of households (i.e., families), while the first set shows a physical count of housing units.

In looking at the two Censuses, we find that the count for the physical units themselves is only 2,143,434 (U.S. Bureau of the Census 1972). On the other hand, the count of households owning vacation homes is 2,889,771 (U.S. Bureau of the Census 1972). It is the author's opinion that the latter number more closely approximated the true extent of the existing market in this country as of 1970 since it compares favorably with previous estimates from other surveys, including: (1) 1,897,882 "vacation" homes from the 1960 Census of Housing; (2) 2,350,000 households owning "second" homes from a 1964 Michigan Survey Research Center Study (Lansing 1964); and (3) 2,970,000 households owning "vacation" homes from an American Telephone and Telegraph Company Study in 1965. If assuming an approximate increase of 150,000 new homes during the past few years, it appears the total standing stock of vacation homes in the United States is now about 3.5 million. This would mean that slightly over 5 percent of all households own a vacation home, and that this type of unit accounts for slightly less than 5 percent of the total housing stock.

As shown in Table 2, over 50 percent of the vacation homes are found in only 10 states, with almost 1/3 being in the five states of Texas, Michigan, New York, Wisconsin, and California. For the most part, states with large numbers of vacation homes have some major recreational amenities, contain or are in close proximity to established metropolitan areas, or are very large in area.

Table 2.--Distribution of Vacation Homes, By State, 1970

State	Total Housing Units	Vacation Homes [a]	Percent of Total Housing Units	Percent of Total Vacation Homes (% of 2,143,434)
U.S.	68,418,094	2,143,434	3.1	100.0
AL	1,120,219	32,663	2.9	1.5
AK	88,428	6,705	7.6	.3
AZ	584,116	16,380	2.8	.8
AR	675,593	27,658	4.1	1.3
CA	6,994,533	96,639	1.4	4.5
CO	757,053	35,467	4.7	1.7
CT	980,849	15,325	1.6	.7
DE	180,212	8,134	4.5	.4
FL	2,526,536	41,735	1.7	2.0
GA	1,471,132	33,683	2.3	1.6
HI	216,066	3,053	1.4	.1
ID	244,681	15,335	6.3	.7
IL	3,701,866	38,722	1.1	1.8

Table 2.--(Continued)

State	Total Housing Units	Vacation Homes [a/]	Percent of Total Housing Units	Percent of Total Vacation Homes (% of 2,143,434)
IN	1,730,020	45,367	2.6	2.1
IA	958,560	29,192	3.1	1.4
KS	791,022	20,724	2.6	1.0
KY	1,064,436	33,332	3.1	1.6
LA	1,150,313	30,833	2.7	1.4
ME	397,140	73,562	18.5	3.4
MD	1,248,747	28,014	2.2	1.3
MA	1,890,319	51,746	2.7	2.4
MI	2,954,451	188,864	6.4	8.8
MN	1,276,082	83,855	6.6	3.9
MS	699,168	28,364	4.1	1.3
MO	1,673,332	64,330	3.8	3.0
MT	246,603	16,225	6.6	.8
NE	514,617	18,521	3.6	.9
NV	172,558	4,277	2.5	.2
NH	280,962	43,908	15.6	2.1
NJ	2,387,535	61,033	2.6	2.9
NM	325,715	14,527	4.5	.7
NY	6,298,385	181,138	2.9	8.5
NC	1,641,131	66,811	4.1	3.1
ND	256,222	14,301	5.6	.7
OH	3,465,161	47,936	1.4	2.2
OK	925,238	27,758	3.0	1.3
OR	744,602	20,946	2.8	1.0
PA	3,924,503	92,813	2.4	4.3
RI	317,193	9,974	3.1	.5
SC	812,148	36,242	4.5	1.7
SD	225,183	15,000	6.7	.7
TN	1,300,183	32,680	2.5	1.5
TX	3,825,299	130,580	3.4	6.1
UT	315,734	7,979	2.5	.4
VT	165,068	27,291	16.5	1.3
VA	1,492,887	46,525	3.1	2.2
WA	1,220,447	45,010	3.7	2.1
WV	597,266	26,230	4.4	1.2
WI	1,472,257	100,336	6.8	4.7
WY	116,323	5,711	4.9	.3

[a/] "Vacation Homes" are enumerated by combining the United States Bureau of the Census categories, "Rural Seasonal Vacant" and "Other Rural Vacant." This combination basically includes housing units which are intended for occupancy during only certain seasons of the year

---

Source: U.S. Department of Commerce, Bureau of the Census, U.S. Census of Housing, 1970, Detailed Housing Characterists, (Washington, D.C. U.S. Government Printing Office, 1972), Final Report HC(1)-B1-52, Table 32.

At the other end of the spectrum are 18 states which contain less than 10 percent of the total vacation homes. For the most part, these are either: (1) isolated in location or very sparsely populated (e.g., Montana, Idaho, Utah, Wyoming, etc.); (2) void of many outdoor recreational amenities (e.g., Kansas, Nebraska, Nevada, etc.); (3) small in land area and highly urbanized (e.g., Connecticut, Rhode Island, Delaware, etc.).

All of the top 20 states contain some outstanding attractions important for the location of vacation homes. Only Missouri and Colorado do not have frontage on an ocean, the Gulf of Mexico, or the Great Lakes. Eight have mountains to provide year-round recreation, and most have a good climate. Also, all top 20 states are located fairly close to large metropolitan areas. When combining these factors, it becomes apparent that population density is not the only location determinant. Of course, many of the same amenities which attract vacation home buyers also attract permanent residents. When considering this fact, it is interesting to note that most of the top 20 states in the absolute ranking increased considerably more in total population between 1960 and 1970 than did the lower 30 states.

Another way of analyzing the distribution of vacation homes is to calculate the percentage of total housing units comprised of vacation homes in each state. In looking at the relative comparisons between vacation homes and total housing units in Table 2, it is noted that only 3.1 percent of all housing units in the United States are classified in the 1970 Census as "vacation homes."

On an individual state basis, the three New England states of Maine, Vermont, and New Hampshire had rates more than twice as high as any other state. Here, year-round population density is low, and vacation homes have been accumulating for decades due to a combination of outdoor recreational amenities and close proximity to large metropolitan areas. In fact, except for Michigan, the top 20 states are generally rural and have relatively small populations.

The 1970 Census of Population included for the first time extensive data describing the owners of vacation homes. These data are "historical" in nature in that the 1970 Census count represents years of accumulation. In other words, the data describe persons already owning vacation homes instead of those who are currently buying or even, more importantly, those who plan to buy in the future. Thus, the count represents thousands of families who have owned vacation homes for many years. Significant variations most assuredly occur between the different sets of buyers, but it is not possible to determine these differences in any great detail.

The 1970 Census only asked questions about vacation home ownership and neglected to include anything on recreational lot ownership, so that few insights are available on ownership patterns for recreational lot owners.

The Census data show that the vast majority of owners (68.0 percent) reside within SMSAs, and that 31.0 percent reside within central cities. However, the rate of ownership (4.1 percent) is lower for central city residents than for any other area. This, of course, is due to the fact that central city populations are weighted by a great number of low-income families who are non-participants in the vacation home market. Some 33.3 percent of all households in the United States live in central cities, whereas only 31.4 percent of all vacation home owners do. However, if family income were cross-tabulated with location, it would probably show that the rate of ownership among higher-income families living in central cities is considerably higher than for comparable income families living elsewhere.

Rate of vacation home ownership is highest (4.8 percent) in the urban balance, which is caused by the high percent of affluent families living in suburbs in comparison with the overall population in those areas. The rate of vacation home ownership outside SMSAs (4.7 percent) also is higher than the national average. Here, the reason is not desire to escape the urban disamenities but, more importantly perhaps, the closer proximity and ease of travel between primary home and vacation home. In other words, families living outside SMSAs for the most part do not encounter congested weekend traffic and find it easier to get back and forth to the vacation home.

The concentration of vacation home owners within a few states is quite evident as shown in Table 3. The top five states (New York, California, Michigan, Texas, and Pennsylvania) contain over 1/3 (36.7 percent) of all households in the country who own vacation homes. The top 10 states (adding Florida, Massachusetts, Illinois, Ohio and New Jersey) contain over 1/2 (56.7 percent) of the vacation home households. On the other end of the spectrum, the bottom 5 states contain only 1.5 percent of the total and the bottom 10 states only 3.8 percent. For the most part, there is a direct relationship between population size and number of vacation home owners.

Table 3.--Distribution of Households Owning a Vacation Home, By State, United States, 1970

State	Total Households	Households Owning a Vacation Home[a/]	Percent of Total Households	Percent of Total Households Owning a Vacation Home (% of 2,889,771)[a/]
United States	63,446,641	2,889,771	4.6	100.0
Alabama	1,034,113	43,108	4.2	1.5
Alaska	79,059	8,389	10.6	.3
Arizona	539,157	36,674	6.8	1.3
Arkansas	615,424	19,863	3.2	.7
California	6,573,861	264,342	4.0	9.1
Colorado	690,928	34,775	5.0	1.2
Connecticut	933,269	45,777	4.9	1.6
Delaware	164,804	9,517	5.8	.3
District of Columbia	262,538	12,905	4.9	.4
Florida	2,284,786	146,020	6.4	5.1
Georgia	1,369,225	50,380	3.7	1.7
Hawaii	203,088	8,463	4.2	.3
Idaho	218,960	12,641	5.8	.4
Illinois	3,502,138	110,933	3.2	3.8
Indiana	1,609,494	59,506	3.7	2.1
Iowa	896,311	30,104	3.4	1.0
Kansas	727,364	22,925	3.2	.8
Kentucky	983,665	32,601	3.3	1.1

Table 3.--(Continued)

State	Total Households	Households Owning a Vacation Home[a]	Percent of Total Households	Percent of Total Households Owning a Vacation Home (% of 2,889,771)[a]
Louisiana	1,052,038	46,877	4.5	1.6
Maine	302,923	35,666	11.8	1.2
Maryland	1,175,073	42,990	3.7	1.5
Massachusetts	1,759,073	112,962	6.4	3.9
Michigan	2,653,059	185,778	7.0	6.4
Minnesota	1,153,946	77,099	6.7	2.7
Mississippi	636,724	20,154	3.2	.7
Missouri	1,520,567	55,750	3.7	1.9
Montana	217,304	15,983	7.4	.6
Nebraska	473,304	15,207	3.2	.5
Nevada	160,052	8,139	5.1	.3
New Hampshire	225,378	17,345	7.8	.6
New Jersey	2,218,182	101,680	4.6	3.6
New Mexico	289,389	18,671	6.5	.6
New York	5,913,861	289,164	4.9	10.1
North Carolina	1,509,564	56,265	3.7	1.9
North Dakota	181,613	10,562	5.8	.4
Ohio	3,289,432	105,129	3.2	3.6
Oklahoma	850,803	31,151	3.7	1.1
Oregon	691,631	30,032	4.3	1.0
Pennsylvania	3,702,304	153,311	4.1	5.4
Rhode Island	291,965	13,337	4.6	.5
South Carolina	734,373	34,829	4.7	1.2
South Dakota	200,807	9,410	4.7	.3
Tennessee	1,213,187	38,451	3.2	1.3
Texas	3,433,996	164,785	4.8	5.7
Utah	297,934	12,222	4.1	.4
Vermont	132,098	11,835	9.0	.4
Virginia	1,390,636	53,133	3.8	1.8
Washington	1,105,587	65,376	5.9	2.3
West Virginia	547,214	23,999	4.4	.8
Wisconsin	1,328,804	76,216	5.7	2.6
Wyoming	104,600	7,340	7.0	.3

[a] "Vacation home" is considered synonymous with the United States Bureau of the Census category "second home," which is defined as, "...a single family house, vacation cottage, hunting cabin, ski lodge, etc., which is owned and held for use sometime during the year by the owners or members of his household."

Source: U.S. Department of Commerce, Bureau of the Census, U.S. Census of Housing, 1970, Detailed Housing Characteristics (Washington, D.C., U.S. Government Printing Office, 1972) Final Report HC(1)-B1-52, Table 37.

Of the top 10 states in terms of absolute umber of vacation home owners, only Michigan emains in the top 10 for rate of vacation ome ownership. Of the top 20 in terms of bsolute number of vacation home owners, only (Michigan, Massachusetts, Florida, Washing-on, and New York) reappear in the top 20.

The primary reason for this variation is uite simple. The most populous states have he greatest number of vacation home owners simply because there are more people to participate in the market. At the same time, however, these densely populated states usually contain several large urban centers. Due to population shifts and economic opportunities, most urban centers contain high proportions of low- to middle-income households that normally are eliminated from participation in the vacation home market. All of these households are included when calculating ownership rates and explain the lower ranking for most of the densely populated states.

States ranking highest in terms of vacation home ownership tend to be concentrated in a few regions of the country. Specifically, these regions are: (1) Northern New England, where vacation home ownership has traditionally been a cultural occurrence; (2) the Great Lakes states; and (3) the Rocky Mountain states. On the other end of the spectrum are many of the southern and mid-western states where average incomes are relatively low and few natural recreational amenities exist.

Other recreational properties

Due to either their recentness and/or smallness, it is almost impossible to estimate the existing magnitude of the markets for resort condominiums, timeshares, and undivided interest. According to most reliable estimates, as will be expanded upon in the following section, it is estimated that roughly 600,000 wholly owned resort condominium units exist in this country. At the same time, it is known that perhaps only a handfull of undivided interest projects exist; probably not involving more than 100,000 owners.

The timeshare market has burgeoned tremendously since its initiation in the late 1970's. Increased demand for timeshare is evidenced by the following gross estimates:

Year	Existing Timeshare Projects	Annual Dollar Volume	Existing Consumers
1977	175	$125 million	100,000
1978	275	$300 million	200,000
1979	350	$750 million	300,000

FUTURE DEMAND FOR RECREATIONAL PROPERTIES

Methodology

Any numerical projections for recreational properties are certainly subject to question. Since recreational property is not a basic necessity such as food, clothing, and primary lodging, it is open to major changes in demand. Most certainly, demand decreases during economic recessions and increases during periods of economic expansion.

As noted earlier, demand for new recreational property has decreased tremendously since 1973 due to negative publicity, market saturation, negative status, environmental concerns, public regulations, the energy crisis, etc. While it appears that demand has again increased since 1976, it seems unlikely that it will ever again reach the proportions realized between 1967 and 1973. At any rate, all numerical projections made in 1980 will be subject to many unforeseen parameters in the future. The reader is cautioned to remember these limitations in applying the following projections for the three major submarkets of recreational lots, detached vacation homes, and resort condominiums. No attempt is made to project demand for the timeshare and undivided interest projects, although it is quite possible that in future years, demand for these commodities will far outstrip the other three.

Steps involved in making the projections include the following:

1. The estimated number of households for the 4 Census regions in 1980 and 1985 were derived from the Bureau of the Census (U.S. Bureau of the Census, 1973).

2. Propensity for future ownership of recreational properties was obtained primarily from a nationwide opinion survey conducted by the Opinion Research Corporation of Princeton, New Jersey. The survey was conducted on a personal interview basis in the homes of the respondents. It involved a weighted sample of 7,190 households throughout the United States.

3. These numerical projections were then reconsidered in light of several other nationwide projections of future demand for recreational properties. These projections were less detailed in regard to type of property or future data and were used simply as benchmarks to ascertain whether the projections derived in (2) were reasonable.

4. The 4 sets of projections were then integrated with subjective interpretation based upon knowledge and insights gained from supporting research. Though the discrepancies between the various sets of projections were surprisingly small, the final projections are somewhat more conservative than those in the 4 mentioned sets of projections. It is felt that persons tend to be overly optimistic about their future plans for purchasing recreational properties. In many instances, such plans are never realized and the discretionary income is allocated to other household items. Recent literature published concerning the market also was reviewed.

Numerical projections

Table 4 presents demand in the United States for various types of recreational properties (as an aggregate), vacant recreational lots purchased for the purpose of building a future vacation home, recreational lots occupied by a single-family detached vacation home, and resort condominium units. Both absolute and relative figures are included in the table. Table 4 presents absolute projections for the four types of recreational properties on a regional basis, while Table 5 presents the same material with relative figures.

Table 4.--Demand for Recreational Properties By Type of Property, United States, Estimated for 1980 and Projected for 1985.

Type of Property	1980	1985
Number of Households	77,000,000	84,000,000
Number of Households Owning Recreational Properties	8,085,000	10,080,000
Percent of Total Households	10.5	12.0
Number of Households Owning Vacant Recreational Lot for Speculation/Investment	1,694,000	2,100,000
Percent of Total Households	2.2	2.5
Number of Households Owning Vacant Recreational Lot for Future Building	1,309,000	1,680,000
Percent of Total Households	1.7	2.0
Number of Households Owning Single Family Detached Vacation Home	4,466,000	5,376,000
Percent of Total Households	5.8	6.4
Number of Households Owning Resort Condominium Unit	616,000	924,000
Percent of Total Households	.8	1.7

For 1980, it is estimated that about 8,085,000 households (or about 10.5 percent of the total) in the United States own one of the 4 primary types of recreational property. Most of these properties (almost 4 million) represent a recreational lot occupied by a single-family detached vacation home. The type with the lowest frequency was the resort condominium (about 400,000).

It is projected that by 1985, the number of recreational properties will increase to over 10 million, which means that about 12 percent of all households will own such property. Significant increases will occur between 1980 and 1985 as the post World War II baby boom reaches the time in the family life cycle when propensity for purchase of recreational property is greatest.

In terms of the type of recreational properties to be demanded, it appears that least increase will be realized in the demand for vacant recreational lots, especially those purchased primarily for speculation or investment purposes. Most significant increases in demand will be for recreational shelter, both single-family detached vacation homes and resort condominiums. In absolute terms, the greatest increase will occur in the detached units, from about 4.5 million to about 5.4 million. In relative terms, the greatest increase will occur for resort condominiums, increasing from .8 percent to 1.7 percent of the households.

On a regional basis, as shown in Table 5, a wider dispersion will occur, partly due to regional shifts in population and household formation and partly due to changing regional propensities for purchase of recreational properties.

It is anticipated that relatively little increase in demand will occur in the Northeast for recreational lots purchased only for speculation or investment purposes. At the same time, the most significant growth for this commodity will occur in the West. Such conditions reflect availability of land, saturation of the market, etc. Similar regional trends are projected to occur for recreational lots purchased for future building of a vacation home, although the variations are less severe. For the latter type of recreational property, most significant increases in absolute terms are anticipated in the South and fewest increases in the Northeast.

For single-family detached vacation homes, the greatest absolute growth will occur in the South and West. The anticipated regional growth patterns for resort condominium units will be even more exaggerated, with very significant increases to occur in the South and West. Such patterns again reflect market saturation, availability of land, lack of consumer opportunity, etc.

Table 6 presents changes in the percent of total households in the region which will own the various types of recreational properties. These figures were derived from the previously mentioned surveys and were utilized in the preparation of Table 6.

Table 5.--Demand for Recreational Properties, By Type of Property, By Region, United States, Estimated for 1980 and Projected for 1985.

Region	A. Number of Households (Percent of Total in Parenthesis)	
	1980	1985
Northeast	16,600,000 (21.5)	17,500,000 (21.0)
North Central	20,500,000 (26.0)	22,000,000 (26.0)
South	25,000,000 (32.5)	28,000,000 (33.0)
West	16,500,000 (20.0)	17,000,000 (20.0)
United States	77,000,000(100.0)	84,000,000(100.0)

Region	B. Number of Households Owning Recreational Properties	
	1980	1985
Northeast	1,746,400 (21.6)	2,167,200 (21.5)
North Central	1,827,200 (22.6)	2,318,400 (23.0)
South	2,482,100 (30.7)	3,255,600 (32.0)
West	2,029,300 (25.1)	2,683,800 (23.5)
United States	8,085,300(100.0)	10,080,800(100.0)

Region	C. Number of Households Owning Vacant Recreational Lot for Speculation/Investment	
	1980	1985
Northeast	347,200 (20.5)	336,000 (16.0)
North Central	406,600 (24.0)	420,000 (20.0)
South	457,400 (27.0)	703,500 (33.5)
West	482,800 (28.5)	640,500 (30.5)
United States	1,694,000(100.0)	2,100,000(100.0)

Region	D. Number of Households Owning Vacant Recreational Lot for Future Building of Vacation Home	
	1980	1985
Northeast	255,600 (18.0)	285,000 (17.0)
North Central	274,900 (21.0)	369,600 (22.0)
South	432,000 (33.3)	571,200 (34.0)
West	366,500 (28.0)	453,600 (27.0)
United States	1,309,000(100.0)	1,680,000(100.0)

Region	E. Number of Households Owning Single Family Detached Vacation Home	
	1980	1985
Northwest	1,036,100 (23.2)	1,236,500 (23.0)
North Central	1,107,600 (24.8)	1,290,200 (24.0)
South	1,357,600 (30.4)	1,585,900 (29.5)
West	964,700 (21.6)	1,263,400 (23.5)
United States	4,466,000(100.0)	5,376,000(100.0)

Region	F. Number of Households Owning Resort Condominium Unit	
	1980	1985
Northeast	129,400 (21.0)	194,100 (21.0)
North Central	163,200 (26.5)	240,200 (26.0)
South	194,000 (31.5)	300,300 (32.5)
West	129,400 (21.0)	189,400 (20.5)
United States	616,000(100.0)	924,000(100.0)

Table 6.--Demand for Recreational Properties, By Type of Property, By Region, Unites States, Estimated for 1980 and Projected for 1985.

A. Percent That Househoulds Owning Recreational Properties Are of Total Households

Region	1980	1985
Northeast	10.5	12.4
North Central	8.9	10.5
South	9.9	11.5
West	12.3	13.9
United States	10.5	12.0

B. Percent That Households Owning Vacation Recreational Lot For Speculation/Investment Are of Total Households

Region	1980	1985
Northeast	2.0	1.9
North Central	1.9	1.9
South	1.8	2.5
West	2.9	3.8
United States	2.2	2.5

C. Percent That Households Owning Vacant Recreational Lots for Future Building of Vacation Home Are of Total Households

Region	1980	1985
Northeast	1.4	1.6
North Central	1.3	1.7
South	1.7	2.0
West	2.2	2.7
United States	1.7	2.0

D. Percent That Households Owning Single Family Detached Vacation Homes Are of Total Households

Region	1980	1985
Northeast	5.2	7.1
North Central	5.4	5.9
South	5.4	5.7
West	5.8	7.4
United States	5.8	6.4

E. Percent That Households Owning Resort Condominium Units Are of Total Households

Region	1980	1985
Northeast	.8	1.1
North Central	.8	1.1
South	.8	1.1
West	.8	1.1
United States	.8	1.1

Influencing Factors

Despite the preceding effort, it is difficult to derive any concrete conclusions about future demand for recreational properties. It appears that the realization of short-term demand will be definitely affected by a series of issues which may or may not be in evidence several years from now. Such current crises facing the recreational land and vacation housing industries as a bad public image, unavailability of financing both for the developer and consumer, the exorbitant costs of building supplies, etc., may continue to exist in the future. However, these items all appear rather inconsequential when assuming a long-range perspective of the markets. For instance, financing rates and availability have traditionally changed drastically within short periods of time; the negative image could be reversed if and when the industry begins to monitor its members; and costs of building supplies and labor have always fluctuated according to the economic climate of the country.

However, when stepping back and considering the long-range future of the markets for recreational properties, a somewhat more complicated picture is portrayed, basically because the influencing parameters become more hazy and confusing and simultaneously more critically influential.

Many long-range indicators portray an optimistic future for increased demand. For instance, it is anticipated that additional discretionary income will become available not only in greater amounts, but also for a larger proportion of the population. Leisure time also will increase and, most significantly, will be available in larger aggregations such as three-day weekends or for extended weeks or even months. Retirement will be possible earlier, and older people will live longer. They also will have more monetary resources available to them, be healthier, and more acquainted with recreational and travel experiences from past participation. The post-World War II baby boom will be reaching the age in the 1980's when propensity for purchase of recreational properties is highest. Interest in nature, ecology, the natural environment, and participation in so-called "healthy and youthful" outdoor recreational activities will continue to increase for wider segments of the population. Thus, most predictions for the so-called opportunity and facilitating factors portray a situation where more and more families will be able to purchase recreational properties.

While these variables are relatively easy to project into the future, at least in numerical terms based upon past trends, a series of other variables also will be very influential. For the most part, these variables are more subjective and thus more difficult to quantify. Their influences will be more subtle but perhaps more critical for long-range future demand for recreational properties.

For instance, the uncertainties of the international situation complicate projections for future personal income in the United States. If the less developed nations of the world begin to demand a more equitable distribution of wealth and resources, either through political or economic coercion, negative effects will most certainly be realized on the GNP of this country. An increasingly larger segment of the population in the United States may perceive the work ethic in a different light in the future and be less motivated toward higher incomes and associated availability of goods and services. Thus, fewer persons may actually have the anticipated discretionary income to buy a second home just for seasonal-recreational purposes, at least in the manner in which many leisure homes are being produced today.

The concern with ecology and preservation of a quality environment does not appear to be a passing fad, but rather one that will continue to increase in the future. More and more communities and states will consider no-growth or limited-growth policies. More and more decision-makers will become more sophisticated about the land development process and will use criteria to determine what type of new land development will prove beneficial to their community in the long-range future. No longer will the only criterion be the possibility of increased contribution to immediate return to the property tax base, but rather more subtle criteria will be used such as costs and benefits related to social, environmental and long-term economic impacts.

Quality land in appropriate proximity to population centers will become less available and much more expensive. More of this land will be maintained in the public domain or placed under much stricter and more rational public control. More land in marginal productivity might have to be used for the support of agriculture and other primary industry in order to satisfy world demands for a more equitable distribution of wealth and resources.

The energy crisis most certainly will effect the future of the market for recreational properties. In the foreseeable future, it seems likely that certain segments of society including legislators and the public t large will question the morality and rationlity of allowing some persons to own and evelop property simply for seasonal-recreaional purposes. The question will most ertainly be raised as to why should a select roup of people be able to afford two relaively expensive homes when a much larger egment of society has never been able to ealize the government's 30-year old goal of "safe and decent" living environment.

Related to the inequitable distribution f wealth in this country are the current ncome tax practices which in some instances ake owning a condominium or rental vacation ome a very profitable venture. It would ppear that public pressure will influence dditional restrictions to be made in regard o these allowed tax benefits and write-offs.

A whole series of additional changes ould occur in the cultural context of our ociety which might affect the future markets or recreational properties. It appears that growing segment of the population is less otivated by status attainment and the fee imple ownership of real property. Although erhaps currently restricted to the youth, here are indications that such changes lowly are penetrating other age-groups. t the same time other subtle factors appear o be gaining in popularity. Included are uch difficult to define items as sense of ommunity, togetherness, sharing, family, oncern with nature, etc. These factors o not necessarily imply changes in demand or recreational properties, but perhaps change in the type of property which is f interest to the consumer.

Related to these comments, is the fact hat our society seems to be ever-increasng in its demand for variety, flexibility, esire for new experiences, etc. More ttractions are becoming available for the tilization of leisure time, and the public eems to be responding in terms of buying hese new concepts and commodities. Travel lubs, camping clubs, new concepts in land wnership, etc., all appear to be increasng in popularity. The opportunity to xperience a variety of recreational ctivities at relatively inexpensive costs as definite implications for the recreaional land industry as we know it today. t would appear that the singular alterative of the fee-simple, single-family etached house on a half-acre lot in a ocation with one limited set of recreaional activities will encounter more nd more consumer competition in the uture from other forms of recreational ursuits.

In sum, the future for recreational roperties is complex. The continuation f past trends and the converging of time, money and attitude seem to suggest a growing market. However, certain unpredictable, long-range factors, such as redistribution of wealth and a heightened energy crisis, may dampen the possibility for an ever-expanding, high-volume market.

LITERATURE CITED

American Land Development Association. 1978. Resort Timesharing. American Land Development Association, Washington, D.C.

Burlingame, Carl. "Evolution of recreational properties," Recreational Land and Leisure Housing Report, (April 17, 1973), p. 1.

Fenton, John. "The second home is a common thing," New York Times, (August 8, 1965), Section 8, p. R.

Kokus, John. 1973. Projections for Future Housing Demand: 1970-1990. National Association of Home Builders, Washington, D.C.

Lansing, John. 1964. Residential Location and Urban Mobility. Survey Research Center, Institute of Social Sciences, University of Michigan, Ann Arbor.

U.S. Bureau of the Census. 1973. Demographic Projections for the United States. U.S. Government Printing Office, Washington, D.C.

U.S. Bureau of the Census. 1972. U.S. Census of Housing, 1970, Detailed Housing Characteristics. U.S. Government Printing Office, Washington, D.C.

Footnotes

1/According to the Bureau of the Census, a vacation home (called second home in the Census), "...may be a single-family house, vacation cottage, hunting cabin, ski lodge, etc., which is owned and held for use sometime during the year by the owner or members of his household." Second homes may also be owned in partnership with members of a different household. The figures indicate second homes which are sometimes rented or leased on a short-term basis to other persons but are principally held for the owner's occasional use during the year. The statistics refer to the number of households that own (one or more) second homes. The data therefore, do not reflect the number of owned second homes.

2/The count for vacation home households represents both an undercount and overcount due to: (1) the fact that while a household could own more than one vacation home, the actual number does not appear; and (2) the fact that while more than one household may jointly own the same vacation home, each family could claim it as their own for purposes of the Census count. It is impossible to determine from the data whether the undercount or overcount is more significant or whether, in fact they come close to balancing out one another.

TRENDS IN HIKING AND BACKCOUNTRY USE[1]

Edward L. Spencer
Herbert E. Echelberger
Raymond E. Leonard
Craig Evans[2]

Pedestrian movement in backcountry settings has increased dramatically in the past 20 years. But the rate of increase seems to be levelling. Some indicators of this trend include the publishing business, the number of equipment manufacturers and outlets, the number of backcountry outfitters, and consultation with entrepreneurs.

For more than a decade there has been an increase in the number of people hiking and camping in backcountry areas. Are there really more people hiking and backpacking or do the same number of people hike and camp more often? Is the trend continuing upward or is it changing? Each year backcountry managers record the use that these areas receive. This data is useful as a guideline for the next year's operational procedures, budgetary concerns and staff assignments. Rarely, however, does the opportunity arise for managers to compare data and establish long-term trends for the use of a large regional area. Such a comparison could provide valuable information for backcountry managers in anticipating their future needs. This paper addresses the issue of trends in backcountry use in the northeast, identifies some indicators of national hiking and backpacking trends, and speculates on possible future pedestrian activities. As was the case with most of the other papers, it was very difficult to assemble comparable and meaningful data on hiking and backpacking trends.

A public survey conducted in 1965 by the U.S. Bureau of Census for the BOR showed that 9.9 million Americans hiked or backpacked. A similar survey, done in 1977 by Opinion Research Corp. under contract to the HCRS (BOR's successor) revealed that 28.1 million Americans backpacked or hiked--nearly a threefold increase.

Similar increases are reflected in actual visitor-use statistics. For example, in the White Mountains of New Hampshire, records of visitors to backcountry facilities are maintained by the Appalachian Mountain Club (AMC). In the 19-year period from 1960 to 1978, AMC hut use quadrupled, increasing from approximately 7,000 visitor nights to approximately 28,000 visitor nights per year (Table 1). In that period, average hut use increased by over 1,000 people per year. Part of this increase is due to an extended hut season and AMC officials feel that the general increase in hut use may have begun to plateau. Comparing use increases for the past ten years with use increases for the past four years shows that use has increased at a much slower rate in the past four than the past ten years.

Records of shelter and tentsite use for the months of July and August in the White Mountains go back only to 1974. Shelter use has remained relatively stable and it is difficult to establish any trends. In 1974, shelter use ran unusually high and was then followed by lower use. Now use is fluctuating around an average of 7,500 visitors. Most of the drop in the 1979 shelter use occured during the month of July. It is speculated that gasoline uncertainties accounted for most of this decrease.

The Allagash Wilderness Waterway in Maine has records dating back to 1966. Visitor use

---

[1] Paper presented at the National Outdoor Recreation Trends Symposium, Durham NH, April 20-23, 1980.

[2] Edward L. Spencer, Chief, Park Planning, Adirondack Park Agency, Box 99, Ray Brook NY
Herbert E. Echelberger, NEFES, U.S. For. Serv., Durham NH
Raymond E. Leonard, NEFES, U.S. For. Serv., Durham NH
Craig Evans, American Hiking Society, Washington, D.C.

of this area increased rapidly compared to other northeastern areas such as Baxter State Park, White Mountains, and Green Mountains. However, there was a drop in use in 1974. The rapid increase in use during the early seventies may have been due to the state acquisition of the Waterway in 1966 resulting in greater publicity. Starting in 1973, however, the Allagash Advisory Committee suggested that publicity agents not publicize the Allagash, that a fee system be established in 1974 to discourage large group use, and that restrictions be imposed to limit party size to twelve persons or fewer. This led to the leveling and decline in use during 1973 and 1974. However, in the next four years, an upward trend was again established. Despite this recent increase measures taken by the Allagash Advisory Committee appear not only to have initially decreased visitor days, but also to have decreased the rate of the following increase.

Table 1.--Visitor use of backcountry areas.

Year	White Mountains New Hampshire		Allagash Waterway Maine	Baxter State Park Maine	Green Mountains Vermont
	AMC Huts	AMC Shelters (JUL & AUG)			8 GMC Shelters (JUL & AUG)
1960	6,927				
1965	13,176				
1966	14,722		4,141		
1967	12,861		4,539		
1968	13,501		3,786		
1969	14,411		4,820		
1970	17,299		5,460		
1971	18,856		6,345		
1972	21,693		8,260		4,726
1973	23,587		8,337	11,684	5,053
1974	24,471	8,187	7,477	10,811	5,765
1975	25,719	7,196	9,477	9,683	6,391
1976	28,426	6,983	8,619	8,983	5,138
1977	26,915	7,705	9,278	7,988	5,067
1978	28,032	7,435	9,734	10,221	4,816
1979		6,250	8,932	10,082	4,449

At Baxter State Park in Maine, use decreased dramatically between 1973 and 1977. This also was the result of management restrictions. Seasonal use decreased at a rate of approximately 900 people per year. However, in 1978 the trend changed and instead of the expected decrease of 900, use increased by 2,233 compared to 1977.

In Vermont, records for eight of the Green Mountain Club's (GMC) shelters for the months of July and August show use peaking in 1975. Then a downward trend began. GMC officials feel that this trend may be the result of new camping facilities that were added to the Club's total shelter system. They do not notice a drop in day use, but agree that the rate of increased hiker and backpacker traffic has leveled considerably. They observed a distinct extension of the hiking season into the foliage season.

At the national level, the U.S. Forest Service has kept records of national forest recreation use by types of activities. This data is summarized in Table 2. As an activity, hiking and mountain climbing has increased steadily from 4 to 11 million visitor-days between 1966 and 1979. As a portion of total recreation use on all national forests, it seems to be increasing in popularity. In 1966, hiking and mountain climbing was 2.8 percent of the total use; by 1970, it had gone up to 3.2 percent; in 1975, it was 4.5 percent; and by 1979, it was 5.1 percent of total forest recreation use.

The only other activity that has captured this increasingly large share of the total national forest system recreation use market is winter sports. It increased from 3.5 percent in 1966, to 3.8 percent in 1970, to 4.7 percent in 1975, to 6.6 percent in 1979. Projections indicate that snow-based activities will continue to dominate the growth scene in the 1980's, followed closely by water and then land-based activities.

The overall long-term trends seem to confirm the folk wisdom that hiking and backcountry use have been increasing over the past decade, but that they may be stabilizing. It is clear that year to year trends do not show any consistency from one recreation area to another, but that over the long-term, most areas have experienced this growth and leveling-off.

The causes for the levels of use and their changes over time are not at all clear. It is a complex interaction of available leisure time, money, accessibility, faddism and more. Each individual processes these variables and makes his decision to go hiking or not. Moreover, this long-term pattern of growth and its more recent leveling-off does not in itself presage future use levels. The leveling-off may continue, dip into a long-term downtrend or merely mark a hesitation in longer term growth. One year does not make a trend. Even two or three years do not. The year-to-year changes are as likely to be in one direction as in the other.

Table 2.--National forest recreation use by activity
(thousands of visitor-days)

Activity	1966		1979	
	Use	Percent of Total	Use	Percent of Total
Camping	39,564.5	26.2	54,780.3	24.9
Recreational travel (mechanical)	31,301.1	20.7	49,536.5	22.5
Fishing	14,709.1	9.7	16,776.0	7.6
Hunting	13,118.6	8.7	15,327.9	6.7
Recreational residence use	7,960.5	5.3	6,651.6	3.0
Picnicking	7,887.5	5.2	8,874.2	4.0
Winter sports	5,219.6	3.5	14,485.0	6.6
Hiking & mountain climbing	4,277.8	2.8	11,176.9	5.1
Organizational camp use	4,287.2	2.8	4,086.8	1.8
Boating	4,006.5	2.6	7,072.1	3.2
Viewing scenes & sports entertainment	3,926.8	2.6	8,321.1	3.8
Resort use	4,003.5	2.6	4,308.9	1.9
Swimming & scuba diving	3,076.9	2.0	4,632.3	2.1
Horseback riding	2,065.9	1.4	3,166.4	1.4
Visitors information services	2,058.8	1.4	4,121.8	1.9
Gather forest products	1,241.7	.8	3,916.1	1.8
Nature study	796.4	.5	1,210.9	.5
Waterskiing & other water sports	641.0	.4	888.0	.4
Games & team sports	585.5	.4	832.8	.4
Total	150,728.9	99.6	220,165.6	99.6

So how does one find indicators of national hiking and backpacking trends, accurately assess them, and meaningfully interpret what they tell us? One way might be to check the marketplace--the place that might profit from an increase in hiking and backcountry interest.

One of the shops in this marketplace is the publishing business. Magazines and books about this subject can be found in almost any bookstore. This was not so a decade or two ago. Publishers such as Scribners, Funk and Wagnalls, Harper and Row, and many others are answering the demand for books on hiking and backpacking. Periodicals such as Appalachia Bulletin, Sierra Club Bulletin, and Living Wilderness have been joined by Backpacker/Wilderness Camping, Mariah, New England Outdoors and Nordic Skiing. Tote books, walk books, and hike books describe thousands of hikes people can take in just about every state in the Nation.

Other shops in this marketplace are the equipment industry and outfitters. Where once hiking and backpacking equipment could be obtained only in large cities or through a few mail-order houses, now many hardware stores carry equipment, many small towns have a sporting goods store and the long-established mail-order houses are under severe competition from hundreds of newly-established businesses. Similarly, perusal of any hiking or backpacking magazine invariably provides one with numerous opportunities for signing up with backcountry and wilderness outfitters. All these entrepreneurs have recognized an expanding market and, in the American tradition, are here to satisfy the demand for these goods and services.

A third way to conjure hiking and backpacking trends is to consult with a panel of people "in the know". If nothing more, this technique should tell us how much agreement or disagreement there is about the future.

James Kern, president of the American Hiking Society, recognizes that the bloom is off the hiking fad, that membership in hiking organizations is not increasing at the same rate it was a few years ago, but that people joining clubs these days are probably doing so after making a more sincere appraisal of their interest in hiking and the individual club.

William Kemsley, Jr., editor of Backpacker/Wilderness Camping magazine also sees only a slight yearly increase in the number of hikers and backpackers. But he foresees a definite increase in snowshoeing, ski camping and family backpacking. As we get more and more into the 1980's, he sees greater interest in "group" camping in the backcountry and use of leantos, shelters, and White Mountain-type "huts".

David A. Richie, project manager of the Appalachian Trail for the NPS, sees an expanding role for volunteers in protection and management of trails and an increase in the responsibilities of trail clubs. He sees them helping decide where trails will go, what land will be bought, and monitoring activities of visitors and landowners to head off conflicts. He also sees them expanding their presence on trails to educate and influence hikers and backpackers on compatible behavior, and taking on added maintenance and construction work, even offering to replace government crews in national parks and forests.

William E. Rennebohm, the Trails Coordinator of the HCRS sees greater use of urban trails, multi-purpose trails, and health or exercise trails. He also feels that low-cost public transportation to distant trails is not beyond the realm of possibilities.

There seems to be general agreement that hiking and backcountry use has experienced a short-term shot in the arm, that the immediate effects of that shot are wearing off, and that the growth rate in this activity will be much less dramatic for the next few years. In summary, we see the American experience paralleling the European experience in pedestrian activity. We see more day hiking and more families hiking. We see more general awareness of walking in our lifestyle, even a trend toward walking as a legitimate mode of transportation for short commutes. We see more of an emphasis on development of the 50- to 250-mile trails rather than on the 1000-mile and over trails; and less emphasis on trail studies and more on-the-ground trail developments.

It seems clear that management policies which are designed to manage use, do in fact have that result. For example, the AMC Hut System, where it has become more and more important to make a reservation to assure oneself a bunk, does not exhibit the dramatic year to year shifts in use that the AMC shelters show. Likewise, Baxter Park's policy restricting use and the Allagash Waterway's policies for discouraging overuse.

Managers and recreationists, for the past decade, have had to cope with the problems posed by rapid increases in use. This has forced difficult decisions, sometimes necessarily made without much data. The problem has been to protect the resource in the face of this increased use. The opportunity now is at hand to review these decisions in the light of experience without the problem of immediate increases and to take stock. Which policies have been successful; which less so? What options should be pursued to make the next decade a successful one for both managers and recreationists?

TRENDS IN EMERGING AND HIGH RISK ACTIVITIES[1]

Robert G. White, Richard Schreyer and Kent Downing[2]

Abstract.--Newly emerging and high risk activities have increased markedly in the last generation, yet little is known about trends in participation. Factors such as technological innovation and creative experimentation with traditional activities appear to play a major role in the development of new activities. Christy's criteria for mass demand in recreation are used to examine the growth potential of different emerging activities. The participation histories of three characteristic activities--skydiving, sport ballooning, and hang gliding--are explored in detail. Trends in activity growth are also seen to be influenced by activity and risk sport image, and by potential for government regulation.

New recreational activities appear to be
erging at an exponential rate, particularly
ose involving an element of risk. Yet,
tle is known about either their participants
the activities. Where and how do new
tivities originate? What determines their
ularity? What trends are evident? What
ecial problems do they have?

THE EMERGENCE OF OUTDOOR RECREATIONAL ACTIVITIES

The origins of new activities can be
aced to two different, though related sources: innovations in equipment or experimentation with participation.

Several activities owe their entire existence to the development of a specific type of equipment or to a breakthrough in equipment materials. In most cases, the critical technology has come from outside the recreational industry. The first hang gliders were adaptations of the Rogollo parawing, a design developed by a NASA engineer. SCUBA diving resulted from the invention of the aqualung, a piece of equipment originally intended for scientific and military purposes. For some activities, the right material was the essential missing ingredient. The kayak and the hot air balloon, for example, have existed for well over a hundred years, yet were rarely used for recreation. Nylon and fiberglass can receive much of the credit for changing that situation. New activities can also result from combining or modifying existing equipment. Surfing and skateboarding together with sailing have yielded board sailing and wind skating, respectively. The addition of motors to hang gliders has spawned the sport of microlight aviation.

Not all activities originate from equipment innovations, though specialized equipment tends to follow if an activity generates enough interest. Rather, a few individuals will explore new techniques and new environments, simultaneously, opening the way for new specialized patterns of participation. Rock climbers are making progress with solo ascents; skydivers are jumping from cliffs;

---

[1] Paper presented at the National Outdoor
creation Trends Symposium, Durham, NH,
ril 20-23, 1980.

[2] Robert G. White is a graduate research
sistant at Utah State University. He re-
ived his B.A. degree in psychology from
gers University, and his M.S. degree in
door recreation from Utah State Univer-
y. Richard Schreyer is an Associate Pro-
ssor at Utah State University. He
eived his B.S. degree in forest recreation
m Utah State University, and his M.S. and
D. degrees in resource planning and con-
vation at University of Michigan. Kent
ning is an Associate Professor at Utah
te University. He received his B.S. and
. degrees in forest management from
orado State University and his Ph.D. in
estry from the University of Missouri.

and SCUBA divers are seeking underwater caves. It is difficult to predict at what point these experiments will create spin-off activities, though the potential for growth likely parallels popularity for emerging activities in general. Three examples of currently emerging spin-offs are out-of-bounds skiing, speed skiing, and free climbing.

DETERMINANTS OF POPULARITY

Christy (1974) outlined five elements that he felt were important for predicting the popularity of a recreational activity, particularly those that would stimulate mass demand. The following sections will apply these criteria to evaluate the potential of several emerging activities.

Ease of Participation

A number of factors are subsumed under this element, including initial costs, operating costs, training, and environmental prerequisites. Although many of the emerging activities require expensive equipment relative to tennis or cross country skiing, they are fairly inexpensive when compared to activities that offer similar experiences. Before hang gliding, the only gliding or soaring aircraft were sailplanes which sell for $10,000 to $35,000. The upper end of the price range for today's hang glider is around $1500. The modern day hot air balloon is one-fourth the purchase price of a gas balloon (the traditional sport balloon) and costs approximately $50 to operate as opposed to $2000 per flight for gas balloons.

The subject of operating costs and hidden costs deserves further discussion. For some activities (hang gliding, board sailing, and rock climbing) the primary expense is equipment, followed by transportation to and from the recreational site. For others such as skydiving there are additional expenses: aircraft fuel and pilot fees.

As Christy points out, the nature of the necessary training can be an important variable for an activity's popularity. Is it short and pleasant or long and difficult? Board sailing involves little or no formalized training. Prospective enthusiasts can often rent a board and practice on their own at their own speed. Would-be skydivers, on the other hand, must adhere to a rigid training program that can be long and costly. To eliminate some of these difficulties, commercial schools (similar to the successful ski schools) have been established to streamline instruction and make it as comfortable as possible.

Environmental prequisites also affect capacity for growth. Board sailors can use a variety of water resources unsuitable for larger sailing craft; and hang glider pilots can fly almost anywhere without worrying about paved landing strips. At the other end of the spectrum, cave explorers and rock climbers are faced with the relative scarcity of adequate resources.

Desirable Image

It is no accident that Madison Avenue has capitalized on the eye catching qualities of hang gliding, river rafting, sport ballooning, and skydiving. In contrast to everyday life, they portray adventure, excitement, and challenge. The transatlantic balloon crossing, the man powered flight across the English Channel, and the conquest of Everest without oxygen were prime examples of individual achievement. Today's recreationists can likewise experiment with new activities in unfamiliar environments, challenging their own frontiers. Undoubtedly, these pursuits can have a powerful effect on self-image as well as on one's public image. The quality of that image, however, may range from envy to bewilderment to charges of being foolhardy and irresponsible. Perception of risk is often a focal point of these images. The influences of safety concerns and perceptions of risk will be discussed subsequently.

Ability for Strong Identification

According to Christy (1974:103), "there must be some paraphenalia, costume, badge or trophy that identifies its holder as a participant in that activity." Nearly all emerging would score high on this element, given the proliferation of t-shirts, hats, belt buckles, patches, and decals sporting slogans and manufacturers names. Distinctive equipment (large and small) can serve the same purpose. Hang gliders, kayaks, and hot air balloon baskets are difficult to miss on car racks and trailers. On a smaller scale, channel locks hung from belts usually identify whitewater rafting guides. Certainly, many participants use these symbols to demonstrate their uniqueness, which becomes a problem when nonparticipants purchase such items as souvenirs or to be fashionable.

Opportunities for Demonstrating Skills

There are considerable differences among activities on this element. Sport ballooning, skydiving, and hang gliding are highly visible;

especially when close to public areas. They also lend themselves quite readily to exhibitions and demonstrations. Likewise, board sailors, jet skiiers, and Hobie Cat sailors are almost always found near high use areas: beaches, lakes, and reservoirs. Cave explorers, rock climbers, and SCUBA divers are not so fortunate. More so than other activiites, they have to depend on the media or on fellow participants for demonstrating their skills.

Comfortable and Efficient Use of Leisure Time

New designs and materials have had an enormous effect on comfort and efficiency. However, there are some factors beyond the scope of technology, as recreationists who depend on weather are painfully aware. Beginners, in particular, are susceptible to weather since they are the least able to handle even marginal conditions. Where weather tends to be unstable, they can expect to spend much of their training time waiting for conditions to improve. For those reluctant to invest precious leisure time for future rewards, the training period can be extremely frustrating. This feeling may be further compounded by a sense of social isolation that frequently accompanies beginner status. Experts tend to be possessive of their activity, especially when forced to share resources, putting beginners in the uncomfortable position of intruders. Where weather and social isolation combine, the popularity of an activity is likely to suffer. Although it is hard to generalize, skydiving and hang gliding tend to fall in this category.

ACTIVITY TRENDS

Now that we have examined those aspects of various emerging activities pertaining to mass demand, let us take an in-depth look at the past, present, and future of three activities: skydiving, sport ballooning, and hang gliding. These particular activities were chosen because of 1) their popularity, 2) their adventure/excitement image, 3) their growth curves, and 4) the availability of relevent background information. Board sailing was to be considered due to its recent phenomenal growth,[1] but was dropped due to an almost total lack of hard historical data.

Source of Data

Since data on actual participation is simply not available, an alternative appraoch was taken--the national organizations for the three activities were contacted and questioned about the participation of their membership. When pressed about previous years, however, most were reluctant to make retrospective estimates. Therefore, the growth curves presented in Fig. 1 represent organizational membership and not total participation. Yet, according to the officials of all three organizations, these figures do reflect what was happening yearly to the total community of participants.

Skydiving

A spokesman for the United States Parachute Association estimates that 35,000 individuals will make a total of about two million jumps this year. Included in that number are first time parachutists--less than 10% of which will make a second jump. Further, only about 1% to 2% will go on to become experienced skydivers. Currently, the USPA has a membership of approximately 16,000 to 17,000 skydivers[2] or about one half of the total participants. The turnover rate (50% per year) indicates that few skydivers remain active for very long, either in USPA or in the sport.

Skydiving dates back to the early barnstorming days, but it was not until the late 1950s that the sport caught on as a general recreational activity. In 1956, the Parachute Club of America was founded with sixty members. (In 1967, the PCA became the United States Parachute Association). Growth was gradual until 1960 when it increased rapidly (Fig. 1). Between that year and 1973, membership rose from 1417 to 17,624 individuals. This period of growth can be traced to three related factors: equipment, mass media exposure, and skydiving schools. Although surplus military equipment was in widespread use in the 1960's, it was either being modified or replaced, resulting in safer and more reliable parachutes. This period also saw its first extensive exposure to skydiving, including the television program--Ripcord. Concommitantly, commercial schools and independent clubs began to multiply, making skydiving readily accessible to thousands of potential customers.

---

[1] The spokeswoman for Windsurfer brand sailboards, the world's oldest and largest manufacturer, predicted they would sell 30,000 sailboards worldwide in 1980 compared to 125,000 sold since 1969.

[2] The figures since 1975 are approximate because membership is on a revolving basis, i.e., members renew the month their membership expires rather than for the calendar year.

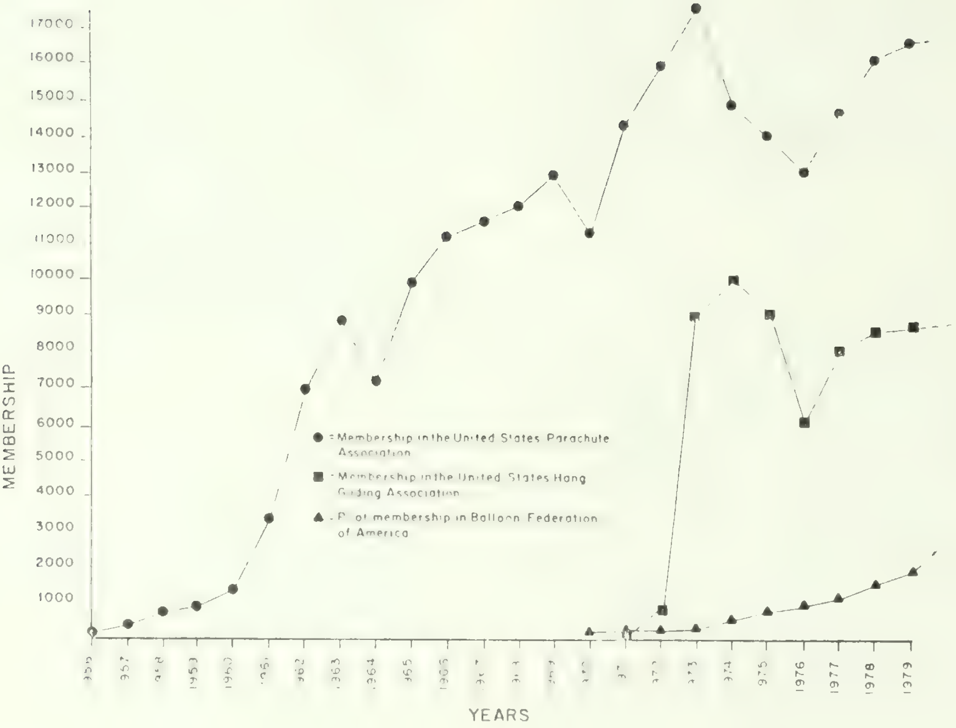


Figure 1.--Membership growth in three activity organizations.

Between the high point of 1973 and 1976, membership declined. A combination of an increase in dues and a general disenchantment with USPA was probably responsible. Therefore, the amount of this dip may not have been indicative of the entire skydiver population. By 1979, membership was again above 16,000. USPA officials believe that membership will stay around this figure for the next few years and that the total number of participants is stabilizing.

Sport Ballooning

Fifteen hundred balloon pilots currently belong to the Balloon Federation of America. According to the membership director, this figure represents 85% of all balloon pilots in the United States. In 1978, there were 1162 thermal or hot air balloons and 12 gas balloons registered with the BFA. During the same year, 38,791 hot air balloon flights were made by members, averaging 13.6 kilometers and about one hour per flight. In addition, the twelve gas balloons made 18 flights.

Sport ballooning in the United States began in the early 1960s with gas balloons, but the hot air balloon soon became more popular. As mentioned earlier, the hot air balloon is considerably cheaper to buy and operate. In 1967, the BFA was founded with 58 members. Three years later there were still only 66 members (Fig. 1). That slow rate of growth continued for several more years until 1973. From then until the present, membership has increased markedly. As with skydiving, better equipment, media exposure, and ballooning schools have all contributed to its growth. Certainly, the media exposure surrounding the successful transatlantic balloon flight (as well as the previous attempts) can be credited with much of ballooning's popularity. Officials of the BFA, in fact, believe that the number of participants will increase for some time to come, though the rate and time frame are uncertain.

Although the sport of ballooning is increasing in popularity, it is unlikely it will ever become a mass demand activity. Besides the initial cost of a balloon and uxillary equipment, it requires a suport crew to aid in launching and retrieving he balloon. To apply for a private baloon pilot's license, a student needs ten ours of free flight with at least six lights under the supervision of an nstructor--that training can cost between 1000 and $1500.

ang Gliding

Compared to sport ballooning and skyiving, hang gliding is a new activity (barely decade old). The national organization or hang glider pilots is the United States ang Gliding Association which claims 8600 embers for 1979. Actual participants, howver, may be as high as 40,000. Beyond that stimate little is known. The problem with stimating participation is that hang liders are easy to transport and can be used n a variety of environments--from backyard ills to beachside cliffs to mountain ridges. here are even portable, power winches that ill pull hang gliders airborne for those ithout an elevated launch site. Wills 1979:20) summarizes the situation well: No one can or will ever know that figure the number of hang gliding flights) until very pilot on the planet punches in on a omputer when he launches ... We can't even ay how many pilots there are in a country, r even state, in a given month. Association nd club membership is only a rough index. ome members fly, some don't. Some pilots re joiners, some anti-organization. Some ly--and die--all by themselves in remote reas."

Despite the inherent difficulties in calulating participation, the staff of the *hole Air Catalog* collected some interesting ata from their readership. Using this data, hey estimated that 1,300,000 flights were ade in 1978 with the majority of pilots aking 9 to 15 flights per month (Johnson 978a). They also discovered that the ighest percentage (24.5%) of pilots still lying today began in 1976 (Johnson 1978b).

The growth curve of the USHGA is truly stounding. In its first three years, memberhip increased from 25[3] to 10,000 individuals Fig. 1). In September of 1974 alone, 4000 eople became new members. Two years later t dropped to 6000 and then rose gradually o its present level of 8600.

There are several possible explanations for this curve. In the early years of the sport (1971 to 1974), the majority of hang gliders were built at home from plans that cost between five and ten dollars. Entire gliders could be built for under $100. As one would expect, the combination "man's oldest dream" at an affordable price attracted everyone from the merely curious to the serious recreationist. By 1974, designers began to turn away from selling plans to manufacturing pre-built gliders. As a result, prices rose to around $500. Today, plans are all but absent and prices are in the $1200 to $1500 range. Undoubtedly this change was responsible for weeding out many would-be flyers. At the same time, new designs were cropping up so rapidly that many became obsolete soon after they were released--a discouraging situation for someone who just invested several hundred dollars. By 1976, most of the radical design changes were over, and manufacturers turned towards refining the hang glider. According to USHGA officials, the chaotic days of hang gliding growth are in the past. The curious and the thrill seekers have dropped out and are being replaced (albeit at a slower rate) by dedicated pilots. In fact, they predict that the present level of participants will remain much the same for the decade ahead.

SPECIAL PROBLEMS

Many of the emerging activities and high risk activities find themselves faced with two problems that could affect future trends: safety and the perception of risk, and government regulations.

The very term--high risk recreation--implies that the activities themselves are inherently unsafe. Many outsiders who might otherwise become participants believe that hang glider pilots, skydivers, rock climbers, etc. are at the mercy of fate, probability, or the elements. Few recognize that the majority of accidents are the result of participant error, not faulty equipment or factors related to the activity itself. For instance, a study of hang gliding accidents (Tongue 1977) found that those most susceptible to fatal injury were pilots with a cavalier attitude towards their participation. Freak accidents do occur, but these are rare. Unfortunately, the mass media tends to overplay the risks involved, giving many activities an undeserved bad image. While the potential for serious injury or even death does exist, the risks can be controlled through skill and experience

---

[3] The original organization was the Southern alifornia Hang Gliding Association.

(Schreyer and White 1979). The image may nevertheless discourage many while encouraging others attracted out of a sense of bravado or thrill seeking. These persons often become the stereotypes reinforcing negative images (and often become through carelessness the accident statistics that maintain those images).

The other factor that may influence future trends is the proliferation of government regulations. Generally, these are of three types: 1) to protect participants from injury; 2) to protect nonparticipants from injury; and 3) to protect the environment. In some cases, national organizations have headed off government intervention by either instituting self-regulations or by lobbying against regulations that could severely curtail participation. Such battles emphasize that there are factors affecting an activity's future which may have little to do with its actual potential for growth. The current use limits on many of the nation's wild rivers is a good example.

CONCLUSION

While the novelty and excitement of new recreational activities, particularly those involving an element of risk, have captured the interest of the mass media, there is an amazing lack of solid information about participation in these activities. Much more is known about the backpacker than the skydiver and the balloonist. In a world governed by priorities, that is perhaps understandable--there are more backpackers than skydivers and balloonists combined. However, if public and private planners are to provide a diversity of opportunities for satisfying different recreational preferences, emerging activities will have to receive the attention they deserve.

The need for information is underscored by the fact that certain emerging activities may be the answer to potential future constraints on recreation participation. Many of today's more popular activites are highly consumptive of precious natural resources. As these resources become scarce, recreational activities will have to change. That change, however, can be as exciting as it is needed. Activities such as hang gliding, board sailing, and free climbing not only use simple, functional equipment that is relatively nonconsumptive; but they are challenging and stimulating as well.

LITERATURE CITED

Christy, Francis T., Jr. 1974. The elements of mass demand for outdoor recreation resources. Pp. 99-103 in B. L. Driver, ed., Elements of outdoor recreation planning.

Johnson, Dan. 1978a. Hang gliding statistics. Whole Air Catalog 1(3):12-13.

Johnson, Dan. 1978b. Hang gliding statistics. Whole Air Catalog 1(4):16-17.

Schreyer, Richard and Robert White. 1979. A conceptual model of high risk recreation. Proc. of 1st Annual Nat. Conf. Recr. Plan. and Devel. Vol. 1, Snowbird, Utah.

Tongue, John R. 1977. Hang gliding injuries in California. J. Trauma 17(12): 898-902.

Wills, R. V. 1979. 1979 hang gliding fatalities: A preliminary look. Hang Gliding 82:20-22.

TRENDS IN DAY USES OF PARKS AND FORESTS[1]

Joseph T. O'Leary[2] John Peine[3] Dale Blahna[4]

Abstract.--Trends for seven day use activities were compared from national recreation survey data collected in 1965, 1972 and 1977. General increases in involvement of the total population was found for the 1965-1977 period. Little change in participation was found for racial and sex characteristics, but shifts in participation were found for age and education groups that could have significant impacts on the future of outdoor recreation.

INTRODUCTION

The United States is a nation that maintains almost a demonic interest in collecting data about just about everything. Participation in outdoor recreation has not escaped this gaze, with several national and many regional, state and local surveys being done since the 1950's. Of all the outdoor involvement that has been measured, day use activities done in parks, forests and other recreation places represent one area that has received substantial attention perhaps because they are pursuits that can be done both locally and regionally and impact almost every facility level.

Unfortunately, it has often been difficult to monitor changes over time in participation because the data needed to do it were not available or exactly comparable. The Bureau of Outdoor Recreation, now known as Heritage Conservation and Recreation Service, has been involved in several national surveys of outdoor recreation. Leisure scientists have found it difficult obtaining the data to allow secondary analysis. This tendency appears to have been changed with the 1977 national survey. Several scientists acquired actual copies of the original data tapes or participated in preparing an assortment of papers that explored various relationships of other data with the 1977 survey results or exclusively concentrated on the survey itself. As the research community learned more about this national data, there was an increasing interest to gain access to actual data tapes of some of the other original national surveys. Beyond initial reporting in the official publications describing results, very little additional study appears to have been made of this information and there has been an absence of comparative analysis. However, three of these national surveys(1965, 1972 and 1977) have become available to researchers at Purdue University and the University of Michigan. Since the surveys contain much information about day use involvement and can be compared for selected questions, this paper will examine seven selected activities and the manner in which involvement is distributed within the population for 1965, 1972 and 1977. The orientation of the paper concentrates on using activity involvement to examine day-use of parks and forest because use has normally been measured in most studies via the activity route. Similarly, the nature of the variables in the data available could be compared most satisfactorily in this way. The material is seen as being exploratory in that no explicit hypotheses are tested, yet because of the absence of previous comparative work, this effort can set the stage for subsequent in-depth secondary analysis.

---

[1] Paper presented at the National Outdoor Recreation Trends Symposium, Durham NH, April 20-23, 1980.

[2] Joseph T. O'Leary, Associate Professor, Purdue University, West Lafayette, Indiana 47907.

[3] John Peine, Project Leader, HCRS, Ann Arbor, Michigan 48107.

[4] Dale Blahna, Research Assistant, University of Michigan, Ann Arbor, Michigan.

PROCEDURE

Copies of the data tapes for the 1965 Bureau of Outdoor Recreation National Recreation survey, the 1972 Audits and Surveys National Recreation Survey and the 1977 Bureau of Outdoor Recreation National Outdoor Recreation Survey were obtained for analysis of the day use activities, bicycling, other boating, fishing, hunting, picnicking, sailing and swimming (pool and other outdoor). Information describing the features of the three surveys is presented in Table 1. Computer analysis of the 1965 and 1972 surveys was done at the University of Michigan and analysis of the 1977 survey was done at Purdue University using similar SPSS statistical package programs. For each year, the activities were examined to obtain the total percent of those who had reported participating. Then five socioeconomic/demographic variables (income, age, race, sex, and education(were used to examine the percent distribution of participation by categories that were common to the three surveys.

In the 1977 survey respondents were asked whether or not they participated in the activities during the previous year and a yes/no response was obtained. However, in both the 1965 and 1972 surveys the respondents were queried about their activity involvement using several different questions. To obtain an aggregate measure of participation in an activity during a year, each question was searched. If there was a positive response to any of the questions, then that respondent was identified as a participant for calculation of percent of the population that was participating in an activity. There should be no double counting.

It is important to note this strategy. After considerable thought this procedure was selected. It appeared to be the logical way to examine the data for the aggregated measure of involvement we needed. However, when the final results are examined, none of the final results are the same as those reported in the "official" 1965 and 1972 publications. In most cases, the data reported here is slightly higher. Thought was given to why these differences might exist, but in the absence of documentation about procedures used in the original tabulations it was impossible to do any type of complementary analysis.

Comparability of the Three Surveys

One of the key issues that needs examination in any use of different data sets is the comparability of the material. In the case of the three national surveys used in this paper there are at least two sources of information that have been consulted. Kirschner Associates (1975) prepared an in-depth review for the then Bureau of Outdoor Recreation of five nationwide citizen surveys dealing with outdoor recreation. Included in this discussion was a comparison of the 1965 BOR Survey and the 1972 Audits and Surveys survey used here. In addition, Blahna (1979) has reviewed and compared the 1972 survey work with the 1977 Outdoor Recreation Nationwide survey.

The Kirschner Associates document is an extensive review (close to 300 pages) that makes comparisons, provides copies of questionnaires and makes recommendation for subsequent work in the citizen survey area. In their comparison of the 1965 and 1972 surveys, a basic finding was that because of the nature of the 1972 instrument the reporting of participation would probably tend to be conservative or underestimated because of the redesign for use in demand equations. Based on their review it does appear that gross comparisons (% of people participating) and types of persons participating in specific activities are possible. Since this was the goal of the "day-use" activity orientation in this paper the comparisons we made seemed reasonable.

Blahna's (1979) review of the 1972 and 1977 surveys also pointed to areas of concern. First, the activity participation reported in the 1977 survey appear to be high based on reviews of other surveys done between 1973 and 1978. This may be related to the low response rate encountered in the telephone interviewing and the tendency of this procedure to include those who are most interested in the subject area.

Of the activities that were examined, the phrasing of the question for swimming created a problem. In the 1977 survey the question linked the activity "sunbathing" to swimming thus identifying two activities and confounding the issue of involvement. We would assume that this would inflate the response to the question.

Finally, to construct a participation percent for each activity in the 1972 survey, the data had to be accumulated from four questions. The first three questions addressed the three summer months of 1972 and inquired about activity involvement on vacations, overnight trips, recreational outings that took the better part of a day, and finally for other short recreation outings. Then another question was posed to ask about a nine month period from September to May and the activities done in that period.

Table 1. Features of the 1965, 1972 and 1977 Survey Samples

	YEAR		
	1965[a]	1972[b]	1977[b]
Type of Interview	Personal	Personal	Telephone
Time Period Coverage	3 summer months	3 summer months plus rest of year	entire year
Number of Respondents	7194	4029	4029
Response rate	91%	54%	51%
Respondent Age	12+	12+	12+
Sample Selection	persons from CPS households	1 person/household in a systematic cluster sample of households	random systematic sampling of counties and random digit dial technique (up to 4 callbacks for no answers

[a] Kirschner Associates (1975)

[b] Blahna (1979)

Table 2. Comparison of 1972 and 1977 survey questions about swimming.

YEAR	
1972	1977
Outdoor pool swimming	Swimming or sunbathing in an outdoor pool
Other swimming	Other outdoor swimming or sunbathing

The subjects in the 1977 survey were read a list of activities and asked whether or not they had done any of those in the last 12 months. This was done on the first page of the survey instrument while respondents were still fresh. The complexity of the 1972 questions may have caused those not particularly interested in the survey to respond negatively simply to get the whole process over with.

RESULTS

Analyses of the overall percent of the population reporting involvement in the period 1965-1972. These decreases are rather dramatic, in some cases indicating that there was a drop in participation of almost 50%. Of course, this is inconsistent with contemporary gospel about recreation use. Yet even in the published material that provided summaries of the 1965 and 1972 data, decreases or relative stability in the amount of use was reported (Kirschner, 1975: Appendix D). There are at least two explanations for these apparent changes. One is that there actually was a downward change in the nation's involvement in outdoor recreation. This is a difficult hypothesis to accept since most on site visitation data suggests continuing growth. Perhaps the more likely reason for the changes is related to the methodological changes that suggest an underestimation of involvement. Yet the differences are still somewhat unusual.

It is important to note that two of the activities - fishing and hunting - showed mild increases in the same period that the other activities were decreasing. The subtle upward change found for fishing (30% to 31%) in our analysis is in opposition to the information that was published describing a decrease from 30% to 24%.

While the analysis done here points toward questions about the original analysis of these two data sets, there is at least a general observation to be made. Although the absolute numbers are not the same, the tendency to report decreases from 1965 to 1972 is consistent for five of the seven activities examined.

In light of the 1972 data, comparing it to the 1977 data is somewhat easier. In every case, participation reported from the 1977 survey shows a dramatic to moderate increase. For example the portion of the population involved in bicycling went from about 21% in 1972 to 50.4% in 1977. Boating involvement doubled; fishing increased 23% over the 1972 level; picnicking rose to a level 20% higher. One of the most intriguing changes is in swimming at a pool which showed 300% growth. A companion activity - other outdoor swimming - increased about 13% over its 1972 level. The swimming changes are particularly confounding because sunbathing was included as part of the activity description. The changes reported suggest measurement of two activities and it is impossible to disaggregate the results to reflect the contribution of each to the overall number. Finally, hunting is the only activity demonstrating a subtle upward meovement from 14.8% in 1972 to 18.7% in 1977.

Table 3. Percent involvement in all activities, 1965, 1972, 1977.

Activity	YEAR		
	1965	1972	1977
Bicycling	29.4	20.9	50.4
Fishing	30.2	31.2	54.2
Hunting	13.5	14.8	18.7
Other Boating	30.4	17.4	36.3
Picnicking	62.2	52.4	73.8
Sailing	7.1	3.0	13.2
Swimming	51.3		
Pool		21.2	66.7
Other outdoor		36.4	49.2

Again an earlier point should be reemphasized. The change in the manner in which questions were asked about participation (one question in the 1977 instrument vs. several questions in 1965 and 1972) and the location of the question right at the beginning of the 1977 instrument may have had a significant effect on response. Similarly, the response rate for the 1977 survey may show some selection of respondents most interested in outdoor recreation.

Participation and Descriptive Population Characteristics

Tables 4 thru 12 provide descriptive socioeconomic and demographic information for those individuals reporting involvement in the day use activities being examined. An initial observation that can be made about this data is that in every activity there are persons from every socioeconomic/demographic category involved. The number of characteristics provided make summary difficult. In addition, the income categories that are used in each of the three surveys are difficult to compare. First, $6000 in 1965 is valued much differently than it is in 1977.

Similarly the 1972 (15,000-24,999;>25,000) and 1977 (25,000-50,000; >50,000) surveys added additional categories to the >$15,000 figure used as the upper level in 1965.

Comparison of the data appears to show that non-white involvement in these activities has changed little in the 12 year period. In some activities there actually appears to be a minor decrease (e.g., hunting, other outdoor swimming, pool swimming, boating and sailing). Small increases or no change in non-white involvement are apparent in bicycling, picnicking and fishing. Similarly, there are significant differences between some activities by sex, but within activities there appear to be few shifts (an exception to this is in hunting).

Age and education appear to be the most complementary categories that can be compared in the three surveys. While there are differences within each group over time, the general shape of these distributions is similar. It is interesting to note that the 1977 data appears to show lower levels of involvement for the younger age groups for virtually all the activities. It also shows higher levels of involvement than ever reported before in the 25-44 age groups for all the activities. This latter observation is especially true for bicycling. Involvement by persons in the 25-44 age group has almost doubled since 1972, and shown a sizeable change since 1965.

Sailing appears to have been a particularly volatile activity (if you can use the word to describe the process) decreasing in involvement for every age group except for those 25-44. Other boating demonstrates a similar tendency.

When involvement in the activities is compared by education levels, the results from the 1965 and 1972 surveys are quite similar. Sharp peaks are apparent in the percent of those with a high school education doing an activity. The 1977 data shows evidence that those reporting a college education are more involved in these day-use activities than ever before. The distributions are rather similar in their general shape. Almost all of these changes represent 100% increases over either the 1965 or 1972 situation. Sailing is an interesting activity in that the 1972 and 1977 data for those with college education and above virtually coincide.

DISCUSSION

The trends in the seven day-use activities provide a point of departure for discussing longitudinal data examinations. It is interesting to consider that we were not able to replicate the exact results that had been officially published. Although a number of attempts to duplicate the original fundings were made, none of these seemed to work. While the results from these analyses appear to be close, it has taken this retrospective review to raise questions about possible differences. The Kirschner Associates report suggested some other considerations that would also lend themselves to possibly clarifying the survey results and making them more useful (exploring selected differences between variables; changing the weighting scheme; evaluation of preferences, etc.). It seems clear that more adequate documentation is necessary for these date sets, something which goes beyond a listing of variables and their column locations.

More research (and secondary analysis at that) should be directed at the surveys to explore in greater detail the complexity of the relationships in the data. For example, the observation that for almost all the day-use activities younger persons (12-17; 18-24) are not participating as a group at the same level as they did in 1965 or 1972 is rather intriguing. Even if we were to disregard the 1972 survey, a change in the 12 years from 1965 to 1977 appears to have taken place. The immediate question to be asked would be if this pattern is the same for all the other activities that could be compared. It would be possible to explore some of the possible reasons for change based on additional questions asked in the 1977 survey. It is also interesting to speculate on what will happen to this group as they become older since some literature appears to suggest that early recreation experiences will impact involvement later on in one's life.

Perhaps one of the more interesting observations from the trend data is the increase in the proportion of the population with college education participating in day-use activities. The change is so dramatic that at least some consideration should be given to the alteration. We would anticipate that this group would maintain an above average income with more of it available for leisure expenditures. Therefore, we might anticipate that there would be greater interest in the acquisition of accoutrements associated with the activities. Similarly we would anticipate a more knowledgeable group of users pursuing the activities under consideration. This would potentially impact the view of the participating public on the management activities undertaken to provide the activities. Managers may find that they will be increasingly questioned about their activities because of the increased involvement

Table 4. Socioeconomic/demographic characteristics for Bicycling, 1965, 1972, and 1977 outdoor recreation survey.

Characteristic	YEAR				
	1965		1972		1977
Income					
<6000	44.9		16.4		7.6
6000-9999	31.0		27.7		15.6
10000-14999	17.2		28.3		25.1
>15000	6.8	15000-24999	20.6		34.2
		>25000	7.0	25000-49999	14.4
				>50000	3.0
Age					
12-17	35.0		43.1		25.3
18-24	14.9		18.6		19.8
25-44	28.4		26.6		39.4
45-64	16.1		9.4		12.2
over 65	5.6		2.2		3.3
Race					
White	88.4		82.6		86.1
Nonwhite	11.6	Black	12.6		10.8
		Other	4.8		3.1
Sex					
Male	46.9		44.1		49.0
Female	53.1		55.9		51.0
Education					
Grade School	7.2		6.9		3.6
Junior High	21.4		18.1		11.1
High School	55.8		50.4		44.7
College	14.1		19.9		33.4
Graduate	1.4		4.7		7.3

Table 5. Socioeconomic/demographic characteristics for Fishing, 1965, 1972, and 1977 outdoor recreation survey.

Characteristic	YEAR				
	1965		1972		1977
Income					
<6000	42.5		21.2		9.5
6000-9999	32.8		32.6		16.7
10000-14999	17.5		27.9		26.1
>15000	7.2	15000-24999	13.7		32.0
		>25000	4.6	25000-49999	13.1
				>50000	2.6
Age					
12-17	23.2		19.6		19.0
18-24	15.3		16.0		15.9
25-44	33.4		36.7		37.7
45-64	22.7		22.8		19.9
over 65	5.4		4.0		7.6
Race					
White	92.8		88.3		88.5
Nonwhite	7.2	Black	8.8		8.8
		Other	2.9		2.7
Sex					
Male	57.6		61.2		58.1
Female	42.4		38.8		41.9
Education					
Grade School	6.8		6.3		3.9
Junior High	18.2		16.1		10.9
High School	57.1		55.2		48.1
College	15.7		18.9		31.1
Graduate	2.2		3.6		6.0

Table 6. Socioeconomic/demographic characteristics for Hunting, 1965, 1972, and 1977 outdoor recreation survey.

Characteristic	YEAR				
	1965		1972		1977
Income					
<6000	49.7		18.5		8.4
6000-9999	30.8		37.0		14.5
10000-14999	14.5		27.7		24.9
>15000	5.0	15000-24999	12.6		35.3
		>25000	4.2	25000-49999	13.7
				>50000	3.2
Age					
12-17	20.5		15.9		17.0
18-24	19.7		17.9		18.5
25-44	35.8		39.8		40.1
45-64	19.6		21.2		18.7
over 65	4.4		5.3		5.6
Race					
White	92.7		91.4		94.1
Nonwhite	7.3	Black	6.7		3.8
		Other	1.8		2.1
Sex					
Male	87.8		81.8		79.9
Female	12.2		18.2		20.1
Education					
Grade School	8.8		5.7		3.8
Junior High	17.2		15.0		9.6
High School	57.7		58.9		52.7
College	14.4		18.3		29.8
Graduate	1.9		2.2		4.1

Table 7. Socioeconomic/demographic characteristics for Boating (Other), 1965, 1972, and 1977 outdoor recreation survey.

Characteristic	YEAR				
	1965		1972		1977
Income					
<6000	37.8		13.0		6.7
6000-9999	33.8		26.6		14.9
10000-14999	20.2		31.7		23.1
>15000	8.3	15000-24999	22.4		34.5
		>25000	6.3	25000-49999	16.9
				>50000	3.9
Age					
12-17	20.9		20.6		18.4
18-24	17.7		17.8		17.0
25-44	33.4		37.1		40.7
45-64	22.5		21.1		17.1
over 65	5.6		3.2		6.8
Race					
White	95.5		93.3		92.6
Nonwhite	4.5	Black	4.8		5.1
		Other	1.9		2.3
Sex					
Male	54.1		49.8		55.3
Female	45.9		50.2		44.7
Education					
Grade School	4.8		4.3		2.6
Junior High	16.1		11.7		8.2
High School	56.9		52.2		45.0
College	19.9		26.0		36.0
Graduate	2.3		5.9		8.1

Table 8. Socioeconomic/demographic characteristics for Picnicking, 1965, 1972, and 1977 outdoor recreation survey.

Characteristic	YEAR				
	1965		1972		1977
Income					
<6000	44.4		20.4		10.3
6000-9999	33.0		32.8		17.2
10000-14999	16.7		26.8		24.8
>15000	5.9	15000-24999	15.4		32.1
		>25000	4.6	25000-49999	13.1
				>50000	2.4
Age					
12-17	18.3		16.0		14.9
18-24	15.4		16.9		14.7
25-44	37.7		36.0		40.0
45-64	21.6		24.2		21.3
over 65	7.1		6.8		9.1
Race					
White	91.4		86.2		87.4
Nonwhite	8.6	Black	10.1		9.7
		Other	3.6		2.9
Sex					
Male	46.0		43.9		47.5
Female	54.0		56.1		52.5
Education					
Grade School	5.7		5.8		2.7
Junior High	17.2		14.3		9.6
High School	57.1		54.4		46.2
College	17.2		20.4		33.1
Graduate	2.9		5.1		8.3

Table 9. Socioeconomic/demographic characteristics for Sailing, 1965, 1972, and 1977 outdoor recreation survey.

Characteristic	YEAR				
	1965		1972		1977
Income					
<6000	36.8		7.2		4.6
6000-9999	31.5		10.6		11.9
10000-14999	20.0		31.7		15.9
>15000	11.8	15000-24999	26.1		35.2
		>25000	24.4	25000-49999	26.6
				>50000	5.7
Age					
12-17	19.5		22.9		19.9
18-24	16.2		23.5		19.2
25-44	33.7		31.5		43.8
45-64	21.4		18.9		14.4
over 65	9.3		3.2		2.7
Race					
White	93.7		97.5		91.3
Nonwhite	6.3	Black	2.0		6.5
		Other	0.5		2.1
Sex					
Male	51.9		54.3		52.2
Female	48.1		45.7		47.8
Education					
Grade School	7.1		3.2		2.3
Junior High	18.9		10.0		7.1
High School	46.8		29.2		33.4
College	23.8		44.9		43.9
Graduate	3.5		12.7		13.4

Table 10. Socioeconomic/demographic characteristics for Swimming, 1965, 1972, and 1977 outdoor recreation survey.

Characteristic	YEAR				
	1965		1972		1977
Income					
<6000	38.2				
6000-9999	34.3				
10000-14999	19.1				
>15000	8.4	15000-24999			
		>25000		25000-49999	
				>50000	
Age					
12-17	25.1				
18-24	19.4				
25-44	36.0				
45-64	16.7				
over 65	2.9				
Race					
White	93.3				
Nonwhite	6.7	Black			
		Other			
Sex					
Male	50.1				
Female	49.9				
Education					
Grade School	4.2				
Junior High	15.3				
High School	57.7				
College	19.7				
Graduate	3.1				

Table 11. Socioeconomic/demographic characteristics for Other Outdoor Swimming, 1965, 1972, and 1977 outdoor recreation survey.

Characteristic	YEAR				
	1965		1972		1977
Income					
<6000			15.8		7.2
6000-9999			29.3		15.9
10000-14999			28.1		25.3
>15000		15000-24999	18.9		33.1
		>25000	7.9	25000-49999	15.5
				>50000	2.9
Age					
12-17			25.3		19.3
18-24			21.2		18.5
25-44			38.5		42.9
45-64			13.5		15.7
over 65			1.6		3.7
Race					
White			89.1		91.5
Nonwhite		Black	6.5		5.8
		Other	4.4		2.7
Sex					
Male			46.8		50.1
Female			53.2		49.9
Education					
Grade School			3.6		2.0
Junior High			12.9		9.1
High School			54.9		44.1
College			23.0		36.0
Graduate			5.6		8.8

Table 12. Socioeconomic/demographic characteristics for Pool Swimming, 1965, 1972, and 1977 outdoor recreation survey.

Characteristic	YEAR				
	1965		1972		1977
Income					
<6000			15.1		7.4
6000-9999			29.1		15.9
10000-14999			28.4		24.0
>15000		15000-24999	19.4		33.4
		>25000	8.0	25000-49999	16.1
				>50000	3.2
Age					
12-17			31.2		19.6
18-24			20.5		18.1
25-44			32.4		40.9
45-64			14.2		17.0
over 65			1.8		4.4
Race					
White			87.3		90.3
Nonwhite		Black	8.0		7.0
		Other	4.7		2.6
Sex					
Male			47.9		49.0
Female			52.1		51.0
Education					
Grade School			5.0		2.7
Junior High			13.4		9.3
High School			51.7		44.9
College			24.1		34.6
Graduate			5.8		8.6

of this group. These are issues that at this point can only be speculated upon. More specific investigation within this group may provide better understanding of the process.

CONCLUSION

The examination of the seven day-use activities suggests both increases in overall recreation involvement since 1965 and shifts within the population of those involved in the activities. However, because of the differences between some of the results reported here and the "official" published data, care must be exercised in the interpretation. A helpful clarification of this analysis could come from within group studies, especially where significant shifts appear to have occurred. Additional secondary analysis of other data may provide further insight into these changes and assist planners and managers in understanding the future of day-use activity involvement and the subsequent resource impacts.

LITERATURE CITED

Blahna, Dale J. 1979. Comparability Report: The 1972 and 1977 Bureau of Outdoor Recreation Nationwide Surveys. University of Michigan, School of Natural Resources. 22 pp.

Kirschner Associates, Inc. 1975. Interim Report Evaluation of Five Previous Nationwide Citizen Surveys. Washington, D.C. 180 pp and Appendices.

TRENDS IN OUTDOOR RECREATION
ACTIVITY CONFLICTS[1]

John J. Lindsay[2]

Abstract.--Conflict caused by outdoor recreation activity groups competing for the same physical and psychological space has given rise to recreation resource planning, allocation and management problems. Research has shown recreation managers can expect certain types of users to be involved in significant conflict about 25 percent of their occupancy time. Well planned and managed outdoor recreation space can significantly reduce or even prevent conflict.

DEFINITIONS

Outdoor recreation conflict is defined s any physical, social or psychological bstruction arising within or between particpants and their recreation goals.

Conflict may be inter- or intra- group n nature and can be identified with cause nd effect relationships.

Conflict is directly related to the uality of the outdoor recreation experince and sets dynamic parameters on the social nd psychological carrying capacity of an utdoor recreation environment.

Outdoor recreation carrying capacity is efined as the physical, biological, social nd psychological capability of the outdoor ecreation environment to support recreation ctivity without diminishing user satisfaction r site quality (Figure 1). It may be further onceptualized as a function of the quantity f the recreation resource, the tolerance of he site to use, the number of users, the type f user, the design and management of the site nd the attitude and behavior of users and anagers (Figure 2).

RECREATION
CARRYING
CAPACITY

INVOLVES THE PHYSICAL
AND BIOLOGICAL COMPONENTS
OF THE SITE AS WELL AS
THE SOCIAL AND PSYCHO-
LOGICAL ATTITUDES AND
BEHAVIOR OF THE RECREA-
TION USERS.

igure 1.--Outdoor recreation carrying capacity - a definition.

A second type of physical conflict occurs hen participants' use of a recreation site results in various kinds of impact on the natural environment.

A third type of conflict which may be termed political, takes place between opposing factions of outdoor recreation vested interests and involves land use allocation decisions. These conflicts are greatly complicated when non-recreation groups such as timber, water, cattle, and mineral interests conflict over the use of the same acreage sought by recreationists.

Finally, a fourth type of conflict exists between the philosophies and practices of natural resource owners and managers and the attitudes and behavior of the recreation seeking public.

---

[1] Paper presented at the National Outdoor ecreation Trends Symposium, Durham, NH, April 0-23, 1980.

[2] Social Scientist and Outdoor Recreation esearch Specialist, Recreation Management Proram, School of Natural Resources, University of ermont, Burlington, Vermont.

CCF(QT,NU,DM,AB)

CARRYING CAPACITY IS A FUNCTION OF QUANTITY OF THE RECREATION RESOURCE, TOLERANCE OF THE SITE TO USE, NUMBER OF USERS, USER TYPE, DESIGN AND MANAGEMENT OF THE SITE, AND THE ATTITUDE AND BEHAVIOR OF THE USERS AND MANAGERS.

Figure [illegible].--A functional definition for outdoor recreation carrying capacity.

This paper will deal only with encounters of the first kind: those that involve inter- or intra-group conflict occurring when participants engage in recreation activity.

The Problem

The conflict problem simply stated, is that recreationists tend to compete for the same physical, social and psychological space during the same time period.

Its causes are many but perhaps the most serious is that the supply of outdoor recreation space, particularly in the eastern region of the United States is diminishing (primarily because of urbanization) while recreation demand for that same space is increasing both in the number of participants and kinds of activities which are often incompatible with one another. Shafer (1975) states in his paper, Impact of Human Needs on the Natural Environments for Recreation, that urban sprawl may consume 19.7 million more acres of potential recreation land by 2000, an area equivalent to the states of New Hampshire, Vermont, Massachusetts, and Rhode Island. Three and a half million acres may possibly go to highways and airports; 5 million acres of hunting and scenic areas from agriculture to public facilities and second homes and in 17 years 2 million more acres will be allocated to power line right-of-ways. At stake in this land reallocation are our recreation resources.

The second major cause of outdoor recreation conflict is the difference in perception, attitude and behavior between motorized and pedestrian users of recreation environments. The growth in the numbers of users of each type is impressive.

The Council of Environmental Quality estimates there are now (1979) 10 million off-road vehicles and snowmobiles being used in the United States by some 43.6 million Americans. Seventy percent of the snowmobiles in the United States are used in the northeast region which has the highest population density and the least amount of public land (Figure 3).

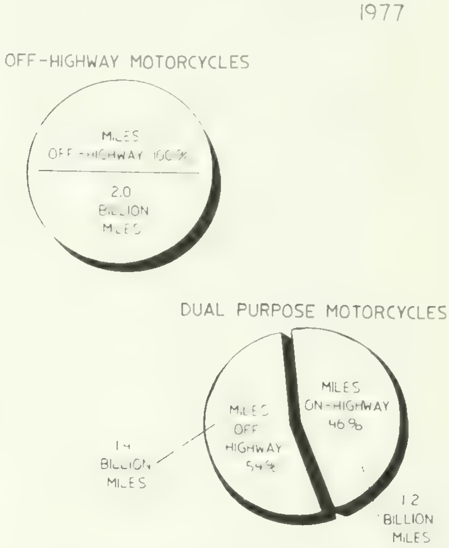


Figure 3.--Miles traveled by off-highway and dual purpose motorcycles in 1977.

There were 670,000 motorcycles sold in the United States in 1969 and 1,050,000 more sold in 1976 accounting for a 57 percent sales increase in 7 years. Motorcycle registrations for these same two years increased from 1.4 million in 1965 to 5 million in 1976 (about a four fold increase).

Pedestrian recreation activity shows similar growth. The National Park Service reports that backcountry use in eastern National Parks has tripled since 1967. The Bureau of Outdoor Recreation estimated there were 10 million hikers 12 years of age and older in 1965, or about 7 percent of the population of the United States. Lucas 1971, quotes a "walking for pleasure" statistic of 68 million people or 48 percent of the population. He then sums the occasions of nature walks, walking for pleasure and hiking and estimates that 1.4 billion pedestrian recreation occasions occur in 1 year in this country. The Bureau of Outdoor Recreation statistics for 1970 estimate 30 million people in the United States have participated in nature walks. The Department of the Interior estimates in the 1974 National Outdoor Recreation Plan Draft that there were 1.9 billion walking activity occasions in 1965 and projects 2.8 billion in 1980 and 4.4 billion in 2000 (U.S.D.I. 1974).

It is possible to conclude from these pedestrian and vehicular recreation statistics that ased on numbers of participants, limited space nd competing activities, the potential for utdoor recreation conflict both within and etween recreation groups is substantial.

A Brief History

In their haste to bring the imbalance be-ween demand and supply to the attention of he American public, the Outdoor Recreation esources Review Commission (1962) did not deal ith conflict or potential conflict between ctivity groups over the use of recreation re-ources except for a limited reference in their eport #5 entitled the Quality of Outdoor Rec-eation as Evidenced by User Satisfaction. In study of participants using 11 selected out-oor recreation areas in the country ranging rom ski areas to National Parks, the Commission eported that respondents indicated under de-lopment and overcrowding as problems they elt needed attention.

The next conflict references in the liter-ure dealt with crowding in wilderness areas d conflicts between backpackers and horse-ack campers, and motorboaters conflicting with noeists (Stankey 1971, Lucas 1964).

Lucas's 1964 Quetico-Superior report con-ined accounts of conflict between motorboat d canoe use of this wilderness waterway. He ported that canoeists "usually wanted no torboats on the waterway" and felt crowded them (Lucas 1961). Lime and Stankey (1971) ate that the perception of the recreation vironment is different between user types and at is a quality recreation experience to one y be entirely undesirable to another (Lime d Stankey 1971). Also, Lucas, Hendee and hers (1964, 1968) report that what the recre-ionist perceives as acceptable or desirable y be quite different from what the recreation nager perceives.

Prausa stated in his 1971 paper on Multi-e-Use Management for Recreation in the East at besides multiple-use conflicts there is other conflict much more difficult to resolve. is the people vs. people conflict and con-rns the conflicts brought about by growth d diversity of various recreation uses of ld lands.

Stankey's Ph.D. thesis dealing with wild-ness recreation carrying capacity reported at "Over half of the hikers in three western lderness areas preferred not to meet horse-n and that loss of solitude at campsites cause of crowding, reduced satisfaction for s study participants" (Stankey 1971).

Wagar (1964) concludes in his Carrying pacity of Wild Lands for Recreation report at "recreation management procudures may allow both high-quality recreation and high rates of use if they: a) reduce conflicts between competing uses, b) reduce the destructiveness of people, c) increase the durability of areas, or d) provide increased opportunities for enjoyment".

The next group of noticeable conflict references in the literature came with the surge in the sale and the public's use of snowmobiles, trailbikes and other off-road vehicles. I have previously stated selected statistics on their use and you have heard Garrell Nichole's discussion of them. Suffice to say that the frequency and magnitude of the social, legal, and environmental impacts caused by off-road vehicles has been cataclismic and that it is only in the last decade that recreation managers, governments and industry have begun to control their use within acceptable social standards. But the problem is far from solved.

Federal land management agencies have differed in the rate and nature of their response to Presidential Executive Order 11644 dealing with ORVS and their use and impact on federal land, but all are currently implementing regulations resulting from the Order (CEQ 1979).

In a well designed effort to bring to light current knowledge concerning the recreation resource carrying capacity problem, Stankey and Lime in 1973 released an annotated bibliography entitled Recreational Carrying Capacity containing 208 citations related to the subject.

Finally in the historical mode, outdoor recreation researchers have recently come under some criticism form sociologists and psychologists for not using established precepts from those disciplines. Bryan (1979) has just released a study report entitled Conflict in the Great Outdoors which is a conceptual framework of outdoor recreation behavior based on sociological and psychological principles.

Concepts From The Literature

In this section of my paper I have annotated key postulates and concepts from the literature to familiarize you with current thinking on the conflict problem.

- In order to manage an area under the carrying capacity concept, managers and the public must set recreation use and environmental impact objectives prior to area utilization. Unless this is accomplished, carrying capacity becomes enmeshed in a sliding scale of uncontrolled use detrimental to site quality and user satisfaction (Lindsay 1979).
- Recreation space demand may be thought of as a sphere whose diameter is set by the greatest space demanding factor associated with that

activity such as noise, speed, distance traveled, solitude or numbers of users per unit area (Figure 4) (Lindsay 1979).

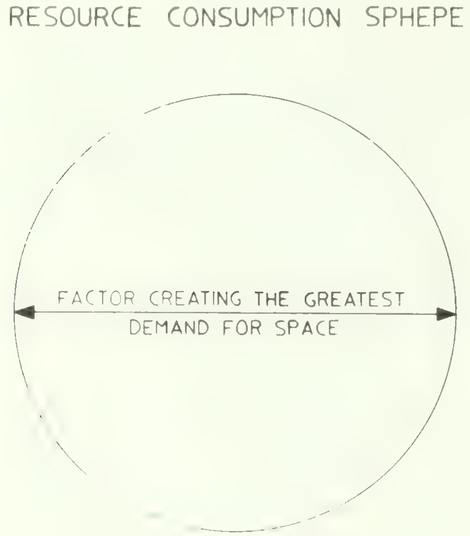

RESOURCE CONSUMPTION SPHEPE
FACTOR CREATING THE GREATEST DEMAND FOR SPACE

Figure 4.--The outdoor recreation space consumption sphere.

- Recreation activity space demand spheres may be completely compatible and concentric on the same site such as those created by nature observers and fly fishermen, or partially compatible and partly overlapping such as those created by sailboaters and boat fishermen, or they may be totally incompatible and demand separate space spheres such as those created by trailbikes and backcountry hikers (Figure 5). Such activities involve single use resource allocations. When the various activity space spheres fill the entire recreation space site sphere, the site is said to be at its point of carrying capacity for a specific period in time (Figure 6) (Lindsay 1979).

- Recreation encounters or path intersects can be measured, predicted and managed (Colton and Pitt 1979).

- Outdoor recreation space occupancy and utilization may be managed by using electronic monitoring and data systems (McCurdy and Wilkens, Shechter and Lucas 1979).

- Activity displacement, for example trailbikers displacing hikers in a recreation management unit, may take place without the area managers' knowledge (CEQ 1979).

- Outdoor recreation plans and objectives must be written for target areas or visitor destination areas (NPS 1976).

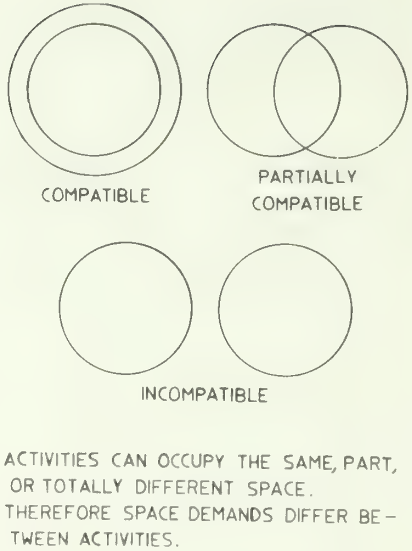

COMPATIBLE
PARTIALLY COMPATIBLE
INCOMPATIBLE
ACTIVITIES CAN OCCUPY THE SAME, PART, OR TOTALLY DIFFERENT SPACE. THEREFORE SPACE DEMANDS DIFFER BETWEEN ACTIVITIES.

Figure 5.--Compatible, incompatible and partially compatible outdoor recreation space demand spheres.

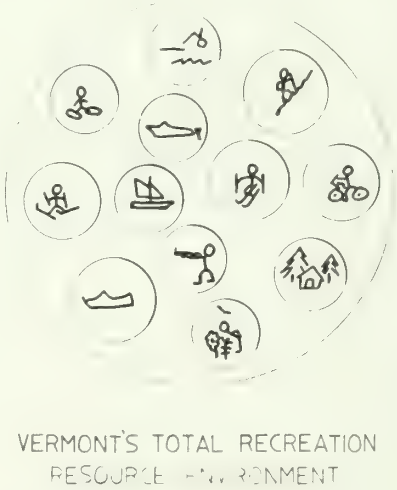


Figure 6.--The outdoor recreation space resource at capacity.

- Recreation managers are being compelled, often unwillingly, to perceive man-environmental relationships as complex ecological entities. It is becoming too costly and too dangerous to perceive them any other way (Schafer 1975).

- Human spatial behavior must be understood before a recreation planner allocates acres to recreation use. The diffusion or circulation of humans in space in order to gain access to recreation facilities or experience space is a major part of this understanding (VanDoren 1975).

- Two major ski areas in Vermont have limited their sale of weekend lift tickets because lift lines were constantly exceeding lift capacities resulting in dissatisfied and non-returning customers (Lindsay 1975).
- Recreationists must lower their threshold of sensitivity to other users (Stankey 1973).
- The number and type of recreationists that can use a recreation area at the same time without destroying user satisfaction or area quality is a basic management decision (Tribe 1972).
- How people perceive outdoor recreation experiences and environments is basic to their levels of actual enjoyment, frustration or conflict (Lime and Stankey 1971, Moeller et al. 1974).
- Users will accept regulation of conduct and movement if (1) they don't know they are being regulated, or (2) if they are educated through sound information and interpretive techniques (Lime and Stankey 1971).
- Defining what is acceptable outdoor recreation behavior is a value choice rather than a technical issue (Lime and Stankey 1971).
- Recreation use can be ratisned through pricing, queing, reservations or lottery (Lime and Stankey 1971).
- Recreation use may be separated by space and time (Lucas 1971, Tribe 1972).
- Depreciative behavior describes behavior that violates institutional restrictions, accepted social norms or both. Too many people on a recreation site may be worse than a lttered campsite (Clark 1971)
- Undesirable (high conflict) uses may be prohibited through closure (Hetherington 1971).
- Outdoor recreation conflict intensity is greatest on urban fringe areas because of limited space, dense populations and a greater diversity of outdoor recreation interests (Lucas 1971).
- Through direct regulation of where visitors may go, how long they may stay and when they may enter the area, management can attain a desired intensity of a use for a particular site. Implicit in these techniques is a trade-off between the loss in the recreationists' freedom of choice and the gain in ability of the site to more nearly meet visitor needs and objectives (Lime and Stankey 1971).
- Use zoning and experience level zoning become critical tactical tools in the effort to manage for high quality recreation experiences (Wagar 1964, USFS 1970).
- Signing (the proper use of signs) can be effectively used to reduce or prevent outdoor recreation conflict (Brown and Hunt 1969).
- Differential fee charges may be used to shift use of off-peak times (LaPage 1968).
- Conflicting uses must be physically separated by distances that depand on the nature of the activity (Lucas 1964, Hendee et al. 1968).
- Some uses should be concentrated while others dispersed over the recreation management unit. This depends on user numbers, facilities needed and potential impact on hardened or natural sites (Lucas 1964).
- Users concepts of crowding are important for managers to understand if they are interested in providing environments in which quality recreation experiences take place (Lucas 1964).
- Managers must decide on the quality of the recreation experience planned for an area and then consciously manage for that experience level (Anon.).

and finally...

- Trophy recreation experiences are legitimate management objectives to which managers must be committed (Anon.).

The Vermont Conflict Study

Even though there are ample references to conflict and carrying capacity in the literature very few researchers have attempted to meausre its frequency and magnitude. Over the past 5 years we have attempted to do this at the University of Vermont with the following results.

Our 1974 exploratory study entitled Outdoor Recreation Conflict in Vermont, revealed that (1) conflict was a problem in Vermont, (2) most recreation activity groups experience conflict but some more than others.

Of the 15 recreation activities studied, 6 were identified as "high conflictors" found to be involved in outdoor recreation conflict at significantly higher rates than the other activity groups. These were snowmobilers, trailbikers, motorboaters, hikers, hunters and fishermen. Private landowners, as a separate study group, incurred the highest rate of conflict as recipients of outdoor recreation use impact.

Our study showed that certain user groups can be predicted to conflict and that the type and cause of their conflict can be forecasted. Based on our findings we were able to recommend conflict solution and prevention measures.

Forty percent of all the recreationists interviewed in our study experienced some sort of outdoor recreation conflict during the 1972-73 season. Twenty-seven percent experienced conflict as recreation participants and 13 percent experienced conflict as landowners conflicting with recreationists using their land.

Recreation participants living in urban areas experienced a slightly higher rate of conflict (29%) than participants living in rural areas (24%). Fifty-eight percent of the conflict occurred in rural areas compared to 42 percent in urban areas.

Subsequent studies of snowmobilers, trailbikers, and motorboaters revealed the following information. Snowmobilers did not believe they were much of a problem to other user groups. Over half (53%) of the sampled snowmobilers said they had experienced no problems while using their snowmobile in 1975. About one-quarter of the respondents cited poor trail and trailside facilities as being their only complaint. Only 4 percent cited conflicts with other recreation groups and these were mostly with cross-country skiers. If you compare these results with our base report, however, other recreation groups and landowners had a much more significat conflict with snowmobilers than the snowmobilers felt they had with these other groups. Lucas, in his 1964 Quetico-Superior study refers to this same phenonemon when he found that motorboaters did not mind having canoeists on the waterway, but the opposite was true for canoeists who did not wish to have motorboaters on "their" waterway and cited many conflicts with their form of motorized recreation activity. The other explanation for the low conflict incidence reported (4%) by Vermont snowmobilers may be that at the time of the study, there had been several thousand miles of approved trails constructed by and for snowmobilers in Vermont and when such a single use, sanctioned facility is built, conflict tends to decrease appreciably.

Thirty-one percent of Vermont trailbikers reported conflict with other groups; 19 percent conflicting with equestrians, 8 percent with law enforcement officials, and 4 percent with hikers and hunters.

Twenty-six percent of Vermont motorboaters studied experienced conflict while boating in our state during 1977. Most of their conflicts were with water skiers and other motorboaters, but included other water recreationists, landowners and law enforcement officials.

If you average the number of Vermont snowmobile, trailbike and motorboat participants that experienced conflict, about 25 percent acknowledged conflict serious enough to report. Data from Vermont hikers is just being analyzed, but at this point in the study it looks safe to say that, based on the "high conflict" sports studied, one out of four participants experience conflict during their activity season.

We further conclude that the intensity, frequency and type of conflict varies considerably with the activity, participant characteristics and the time and place the activity takes place.

Conclusion Statement

Outdoor recreation planners and managers not only have the responsibility to provide high quality natural environments for recreation activity, but perhaps more importantly, they must control or prevent conflict between participants. It is only by such dual objective efforts that high levels of user satisfaction and site quality can be maintained and that managers can feel confident that the recreation product consumed on their lands will be of a superior nature.

Literature Cited

Brown, Perry J., and J.D. Hunt. 1969. The influence of information signs on visitor distribution and use. Journal of Leisure Research 1(1):79-83.

Bryan, Hobson. 1979. Conflict in the great outdoors. Sociological studies No. 4. Bureau of Public Administration; University of Alabama. 98p.

Clark, Roger N. 1971. Undesirable behavior in forest campgrounds. In Recreation Symposium Proceedings. Northeastern Forest Experiment Station, U.S.D.A. Forest Service, Upper Darby, PA. pp 96-102.

Colton, Craig W., and D.G. Pitt. 1979. Examining recreational boating patterns with aerial photographs and interviews. Research paper presented at the Recreation Research Symposium, National Recreation and Park Association Conference, New Orleans, October 1979. Department of Recreation, University of Maryland, College Park. 17p.

Council on Environmental Quality. 1979. Off-road vehicles on public land. Superintendent of Documents U.S.G.P.O., Washington, DC. 84p.

Hendee, John C., W.R. Colton, Jr., L.D. Marlaw, and C.F. Brockman. 1968. Wilderness users in the Pacific northwest - their characteristics values, and management preferences. Research

Paper PNW-61. U.S.D.A. Forest Service. 92p.

Hetherington, John W. 1971. The snowmobile. In Recreation Symposium Proceedings. Northeastern Forest Experiment Station, U.S.D.A. Forest Service, Upper Darby, PA. pp 143-148.

Jacob, Gerald. 1977. Conflict in outdoor recreation - the search for understanding. Utah Tourism and Recreation Review 6(4);5. Utah State University, Logan.

Lime, David W. 1977. Principles of recreation carrying capacity. In Proceedings of the Southern States Recreation Research Applications Workshop. Gen. Tech. Rep. SE-9. Southeastern Forest Experiment Station, U.S.D.A. Forest Service. Asheville, NC. p.302.

Lime, David W., and G.H. Stankey. 1971. Carrying capacity; maintaining outdoor recreation quality. In Recreation Symposium Proceedings. Northeastern Forest Experiment Station, U.S.D.A. Forest Service, Upper Darby, PA. pp 174-183.

Lindsay, John J. 1974. Outdoor recreation conflict in Vermont. Res. Report SNR-RM2. Recreation Management Program, School of Natural Resources, Univ. of Vermont, Burlington, VT. 46p.

Lindsay, John J. 1975. Snowmobiling in Vermont. Res. Report SNR-RM3. Recreation Management Program, School of Natural Resources, Univ. of Vermont, Burlington, VT. 23p.

Lindsay, John J. 1978. Vermont trailbike study. Res. Report SNR-RM5. Recreation Management Program, School of Natural Resources, Univ. of Vermont, Burlington, VT. 30p.

Lindsay, John J. 1979. Boating conflict in Vermont. Res. Report SNR-RM8. Recreation Management Program, School of Natural Resources, Univ. of Vermont, Burlington, VT. 12p.

Lucas, Robert C. 1971. Hikers and other trail users. In Recreation Symposium Proceedings. Northeastern Forest Experiment Station, U.S.D.A. Forest Service, Upper Darby, PA. pp 113-122.

Lucas, Robert C. 1964. The recreational capacity of the Quetico-Superior Area. Res. paper LS-15. Lakes States Forest Experiment Station, U.S.D.A. Forest Service, St. Paul, MN. 34p.

McCurdy, Dwight R., and R.S. Wilkins. 1973. A complete approach to determining outdoor recreation capability of a large tract of land, Shawnee National Forest, Ill. Dept. of Forestry Pub. #13, Southern Illinois Univ., Carbondale.

Moeller, George H., R. MacLachlan, and D.A. Morrison. 1974. Measuring perception of elements in outdoor environments. Res. Paper NE-289. Northeastern Forest Experiment Station, U.S.D.A. Forest Service, Upper Darby, PA. 9p.

Motorcycle Industry Council. 1978. Motorcycle statistical annual. Morotcycle Industry Council, Newport Beach, CA. 47p.

Outdoor Recreation Resources Review Commission. 1962. The quality of outdoor recreation: as evidenced by user satisfaction. ORRRC Study Report 5. Washington, DC. p 44.

Prausa, Robert L. 1971. Multiple-use management for recreation in the east. In Recreation Symposium Proceedings. Northeastern Forest Experiment Station, U.S.D.A. Forest Service, Upper Darby, PA. pp96-102.

Shafer, Elwood L., Jr. 1975. The impact of human needs on the natural environments for recreation. Proceedings: Indicators of Change in the Recreation Environment - A National Research Symposium. Penn State HPER Series No. 6. Pennsylvania State University. pp327-334.

Shechter, Mordechai, and R.C. Lucas. 1979. Simulation of recreational use for park and wilderness management. Published by John Hopkins Press for Resources for the Future.

Stankey, George H. 1971. The perceptions of wilderness recreation carrying capacity: a geographic study in natural resources management. Ph.D. dissertation, Michigan State University. 351p.

Stankey, George H. 1973. Visitor perception of wilderness recreation carrying capacity. Research Paper INT-142, 1973. Intermountain Forest and Range Experiment Station, U.S.D.A. Forest Service, Ogden, UT. 57p.

Stankey, George H., and D.W. Lime. 1973. Recreational carrying capacity: an annotated bibliography. Gen. Tech. Rep. INT-3. Intermountain Forest and Range Experiment Station, U.S.D.A. Forest Service. 45p.

Tribe, Charles B. 1972. Recreation carrying capacity. Division of Recreation and Lands, Northern Region, U.S. Forest Service. 23p.

U.S. Department of the Interior. 1974. The recreation imperative: a draft of the nationwide outdoor recreation plan. Committee on Interior and Insular Affairs.

U.S. Department of the Interior. National Park Service. 1976. Planning process. National Park Service, Washington, DC. 56p.

U.S. Forest Service. 1970. The west slope of the Wind River range: recreation campsite plan. Bridges National Forest, Intermountain Region, U.S.D.A. Forest Service. 65p.

Wager, J. Alan. 1964. The carrying capacity of wildlands for recreation. Forest Service Monograph 7. Society of American Foresters. Washington, DC. 24p.

Wager, J. Alan. 1974. Recreational carrying capacity reconsidered. Journal of Forestry. Vol. 72, No. 5. Socity of American Foresters. Washington, DC. pp274-278.

TRENDS OR METHODOLOGICAL DIFFERENCES?[1]

Daniel J. Stynes, Malcolm I. Bevins
and Tommy L. Brown[2]

Abstract.--Inconsistency in data collection has confounded attempts to identify and forecast outdoor recreation trends. Problems are highlighted through an evaluation of the methods employed in national outdoor recreation participation surveys and projections. Recommendations are advanced for improving data collection, trend measurement, and forecasting within outdoor recreation.

INTRODUCTION

Forecasting is an exciting and challenging endeavor. This is especially true in an environment as dynamic and complex as that which surrounds outdoor recreation in North America. For some, forecasting is merely fun and interesting while for others, it is an integral part of the decisionmaking and planning process.

Planners may be classified into three groups based upon their views of forecasting. Incrementalists do not try to forecast, generally reacting to events instead of trying to anticipate and guide them. For comprehensive-rationalists forecasting is essential. Their view of planning is based upon an ability to identify goals, formulate alternative courses of action, forecast, and evaluate the alternatives within a changing environment. Trend identifiers assume a compromising stance recognizing both the difficulties of forecasting as well as its importance. They typically monitor changes over time, extrapolating from these observations to produce short-range forecasts on which to base planning decisions.

We shall ignore the incrementalists based upon a belief that there is no such thing as "not forecasting" (Mendell 1969). A willingness to observe and explain outdoor recreation systems leads to an ability to predict their behavior. This may take the form of trend identification or forecasting by means of formal or informal models.

Recent attempts to identify outdoor recreation trends and to forecast the future provide some guidance for planning and decisionmaking. These efforts also raise many questions, suggesting that both historical trend data and forecasts of outdoor recreation be interpreted and applied with considerable caution.

Those who use trend information and forecasts must be aware of the underlying methods in order to evaluate the quality of the information and its applicability to a given decisionmaking situation. Our purpose here is to provide guidance to users of trend information and to make recommendations for improving the quality and applicability of outdoor recreation trend monitoring and forecasting efforts. While the focus is upon methods, the final objective is to contribute to the provision and utilization of better information to aid decisionmakers who must cope with and plan for a changing outdoor recreation system.

The title of our paper embodies several questions, some related to data collection and measurement and others related to the selection of a forecasting method or model. For trend identification, the basic question is whether the outdoor recreation participation data collected in the past is indicative of trends or merely reflects a wide range of differences in data collection methods.

---

[1] Paper presented at the National Outdoor Recreation Trends Symposium, Durham NH, April 20-23, 1980.

[2] Department of Park and Recreation Resources, Michigan State University; Department of Agricultural and Resource Economics, University of Vermont; and Department of Natural Resources, Cornell University; respectively.

Forecasting involves the application of a model to an existing data base. In evaluating forecasts one must be concerned with both the quality of the data base and the tenability of the assumptions underlying the forecasting model.

Our ability to predict where we will be in the future depends significantly on knowing where we were in the past and where we are today. Thus, we begin with a discussion of trend identification and trend measurement before delving into the more complex field of forecasting.

TREND IDENTIFICATION

Trend identification is based upon past measurements of outdoor recreation participation (and related events) and present monitoring of these same variables, as a guide to predicting future participation rates. Attempts to identify outdoor recreation trends from secondary data sources have met with numerous problems.

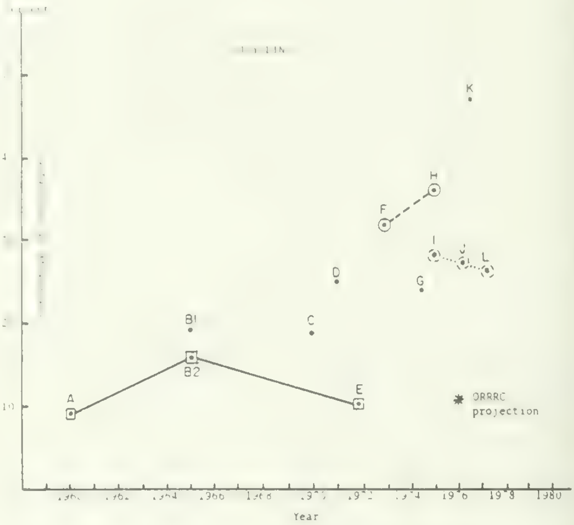
Trend identification is dependent upon reliable and valid data collected in a consistent manner over time. For outdoor recreation most basic data is either not collected, is inaccurate due to poor measurement techniques, or is collected inconsistently over time using non-comparable methods. Much historical data is not documented sufficiently to permit evaluations of its quality or applicability.

The state of existing outdoor recreation data bases suggests that trend identification and forecasting have not been the primary purposes of most data collection efforts. Most data collection is aimed at solving current problems. Potential use of such data for trend identification and forecasting is largely accidental. A good case in point is the series of nationwide outdoor recreation participation surveys.

Trend Identification from Nationwide Participation Surveys

Bevins and Wilcox (1979) have examined 22 national outdoor recreation participation surveys conducted between 1959 and 1978 in an attempt to identify trends in American's participation in a variety of outdoor recreation activities. The surveys examined include the Outdoor Recreation Resources Review Commission (ORRRC) studies, five nationwide surveys sponsored by BOR (now HCRS), three national camping market surveys (USFS), four surveys of hunting and fishing (USFWS) and seven market surveys conducted by private organizations.

Trend data for 28 different activities were examined, revealing some trends and a host of trend identification problems. The difficulties involved in discerning trends from nationwide surveys may be illustrated by an example. Figure 1 graphically depicts trend data for bicycling participation from 13 different surveys. Lines connect those surveys employing similar methods. The sponsor and methods for each survey are summarized in Table 1.



Symbol	Contact	Recreation period	Age of respondent	Position in household
⊙ ⊙	Personal	Year	18+	Individual
⊙----⊙	Telephone	Year	All	Individual
⊡——⊡	Personal	Summer	12+	Individual

A, B, C. letters refer to surveys as identified in Table 1.

Figure 1. Bicycling—trend lines connecting surveys with similar methodologies, 1960-

Bevins and Wilcox 1979

No clear trend emerges for bicycling. Participation rates range from a low of 9 percent in the 1960 ORRRC survey to a high of 47 percent in the most recent BOR (HCRS) telephone survey. Some of the differences are partially explainable by differences in methods, survey populations, or the period for which data was requested. We expect participation rates from surveys of year-round activity to be higher than for surveys restricted to the summer months. Studies including younger age groups should yield higher participation rates in youth-oriented activities than surveys of adults. Other differences in measured participation rates over time may reflect legitimate trends. Sorting out which differences are due to methods and which are the result of trends is a difficult, if not impossible, task.

Table 1.--BICYCLING-participation rates according to nationwide recreation surveys, 1960-77.

Code	Year	Name	Characteristics of survey Type of bicycling	Contact	Recreation period	Age of respondent	Position in household	Percent of population participating
(A)	1960	ORRRC	All	Personal	Summer[a]	12+	Individual	9
(B1)	1965	BOR	All	Personal	Year	12+	Individual	19
(B2)	1965	BOR	All	Personal	Summer[b]	12+	Individual	16
(C)	1970	BOR	All	Mail	Year	12+	Individual	19
(D)	1971	BOR	All	Personal	Year	10+	Individual	25
(E)	1972	BOR	All	Personal	Summer[a]	12+	Individual	10
(F)	1973	Nielsen	All	Telephone	Year	All	Individual	32
(G)	1974-75	TGI	All	Personal	Year	18+	Individual	24
(H)	1975	Nielsen	All	Telephone	Year	All	Individual	36
(I)	1975	TGI	All	Personal	Year	18+	Individual	28
(J)	1976	TGI	All	Personal	Year	18+	Individual	27
(K)	1976-77	BOR	All	Telephone	Year	12+	Individual	47
(L)	1977	AFI	All	Personal	Year	18+	Individual	26

[a] The summer period is June-August.

[b] The summer period is June-Labor Day

SOURCE: Bevins and Wilcox (1979)

Privately sponsored market surveys have shown greater consistency in methods than those sponsored by BOR. Nielsen measured an upward trend in bicycling between 1973 and 1975. Studies by Simmons Market Research Bureau (TGI) and the American Forest Institute (AFI) indicate a slight downward trend since 1975. The BOR surveys illustrate a rather amazing variety of methods and results, providing little guidance for trend identification.

For selected other activities long term trends are more readily identified. Camping exhibits a gradual upward trend in all data series (Fig. 2) and hunting shows a fairly consistent gradual decline since 1960 (Fig. 3). Bevins and Wilcox (1979) report similar graphs for participation in 28 activities and sales of selected recreation equipment. The interested readers should consult that report for further details.

Influence of Survey Methods on Results

Examination of these nationwide studies may tell us more about the effects of alternative survey designs than about trends in participation. Unfortunately few users of the data produced in these surveys carefully examine the underlying methods in order to accurately interpret and evaluate the results. Participation rates are often reported without specifying the time period represented, the age groups included, the data collection method, the sample size, and other pertinent information. The resulting figures are thus prone to misuse.

Although we know that the methods employed will affect survey results, methodological research to date does not yield conclusive information on the magnitude of these effects. In comparing surveys conducted on different populations at different points in time, it is impossible to separate methodological effects from trend effects. A clearer picture of the potential influence of methods upon results is best obtained through controlled experimental designs. Little such research has been carried out with respect to recreation participation surveys, although some guidance is available in the general survey research literature.

Lacking controlled experiments, some insight may be gleaned by comparing surveys with similar methods conducted during the same year. This opportunity was provided in 1977 when both HCRS and NE-100[3] conducted surveys of outdoor recreation participation. Stynes (1979) addresses questions of survey comparability in the two studies.

---

[3] NE-100 is a Northeastern Regional Research Project examining "Recreation Marketing Adjustments in the Northeast."

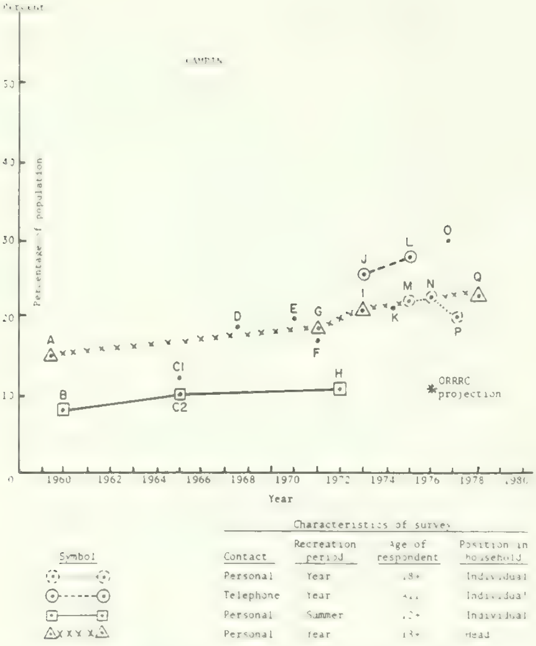


Figure 2. Camping—trend lines connecting surveys with similar methodologies, 1959-78.

SOURCE: Bevins and Wilcox (1979)

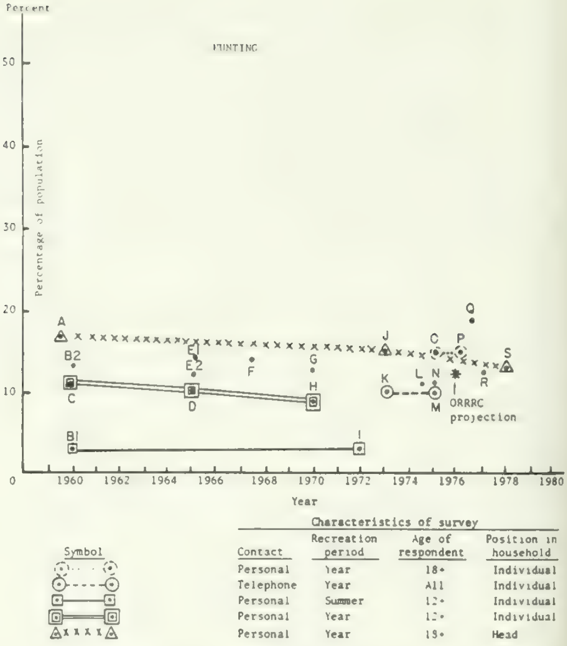


Figure 3. Hunting—trend lines connecting surveys with similar methodologies, 1959-78.

SOURCE: Bevins and Wilcox (1979)

The NE-100 survey included persons 18 years of age and older living in the Northeastern United States, while the HCRS survey was national in scope and included individuals 12 years and older. By selecting only those national survey respondents 18 or older and residing within the Northeast, a subsample comparable to the NE-100 population was obtained. Allowing for sampling errors in the two surveys we would expect (at a 95% confidence level) that the estimates of participation in outdoor recreation activities from the two surveys would be within from two to four percent of each other. Table 2 shows this to be the case for activities that were defined in a similar manner (those above the dotted line).

Of the 22 activities included in the NE-100 survey and 30 in the HCRS study, only 12 are directly comparable. Of these dozen activities, only picnicking reveals differences significantly greater than sampling error tolerances. The variation in the definition and grouping of activities below the dotted line (Table 2) illustrates a common problem in comparing the results of two surveys. When definitions or groupings of activities change even slightly from survey to survey or year to year, few clues about recreation trends for these activities can be discerned.

Differences in recall periods, response rates, question wording, question sequencing, timing of the survey, and a variety of method-related variables will also affect survey results. Examination of the variety of nationwide survey methodologies suggests that many differences in survey findings over time are due to methodological differences and are not necessarily indicative of outdoor recreation trends.

This means that those who use survey data must exercise caution in their interpretation and application. As a guide we offer a checklist of factors to consider in comparing or evaluating outdoor recreation survey results for the purpose of identifying trends (Table 3).

In using a given survey result for a planning or management decision both the quality of the survey methods and the generalizability of the results to the situation at hand must be evaluated. In trend identification it is important that each survey employ comparable methods on comparable populations. Differences in outdoor recreation participation measured in two surveys may result from different survey populations, different contact methods, or minor differences in question wording or recall periods. Differences may simply reflect sampling error, may be due to non-sampling errors, or may be indicative of a trend.

TABLE 2. -- COMPARISON OF HCRS AND NE-100 OUTDOOR RECREATION PARTICIPATION ESTIMATES

NE-100		HCRS	
Activity	Percent Participating	Percent Participating	Activity
Bicycling	42	42	Bicycling
Boating (sailing)	11	14	Sailing
Golfing	16	13	Golf
Hunting	11	13	Hunting
Picnicking	60	69	Picnicking
Skiing (downhill)	11	9	Downhill Skiing
Skiing (cross country)	4	3	Cross Country Skiing
Skiing (water)	10	12	Waterskiing
Snowmobiling	8	10	Snowmobiling
Ice Skating	22	24	Ice Skating outdoors
Tennis	30	30	Tennis outdoors
Canoeing	12	13	Canoeing, Kayaking, River Running
Fishing (freshwater)	24	40	Fishing
Fishing (saltwater)	19		
Boating (motor)	11	32	Boating (other)
Camping (RV)	11	20	Camping in a developed area
Camping (tent)	16	14	Camping in a primitive area
Camping (backpack)	8	27	Hiking or Backpacking
Hiking	25		
Jogging	27	68	Walking or jogging for pleasure
Motorcycling	11	21	Driving vehicles or motorcycles off-road
Swimming	59	63	Outdoor Pool Swimming or Sunbathing
		48	Other Outdoor Swimming or Sunbathing

SOURCE : Stynes (1979)

FORECASTING

Inconsistencies in data collection have made trend identification difficult. Since trend data is a basic input to forecasting models outdoor recreation forecasting has been similarly constrained. The lack of time series data on recreation participation and explanatory variables has limited the types of forecasting models that might be used. In evaluating a forecast one must evaluate the accuracy of the data inputs (the base period figures, for example) and the validity of the forecasting model assumptions.

Given a set of historical data, different models applied to this data may yield different results. Differences in forecasts will be due to the different assumptions of each model. An understanding of these assumptions is essential to evaluation of the forecast. Ideally one evaluates the tenability of the various assumptions for the situation under study in order to evaluate the applicability of alternative models. Practically, questions about the quality or availability of data inputs for outdoor recreation have often pre-empted evaluation of forecasting model assumptions themselves.

Recreation Forecasting Methods

There are a variety of both qualitative and quantitative forecasting models to choose from. Martino (1972) provides an excellent summary of long-range technological and social forecasting techniques and Wheelwright and Makridakis (1973) review shorter range techniques widely applied in business management.

Moeller and Echelberger (1974) review the forecasting techniques most often applied in outdoor recreation. These tend to be middle-range forecasts. For predicting future levels of outdoor recreation participation, two basic types of forecasting models dominate: (1) trend extension models and (2) structural models relating participation in outdoor recreation to explanatory variables that are more readily forecasted. Each method has advantages and disadvantages.

Trend Extension

Trend extension follows naturally from trend identification and monitoring, and is highly dependent upon the quality and consistency of trend data. As its name implies, the method simply involves the extension of trends as revealed in historical measurements of use or participation. The method works well as long as the underlying forces producing a given trend do not change significantly. This assumption is generally valid for making projections one to three years into the future

TABLE 3. CHECKLIST FOR EVALUATING OR COMPARING OUTDOOR RECREATION SURVEYS

1. What is the study population?
   - the study region
   - the minimum age for inclusion
2. What is the method of contact?
   - telephone
   - personal interview
   - mailed
   - on site or household design
3. For household designs, how was the respondent selected within the household?
   - person who answers
   - household head
   - randomly selected
   - based upon quotas
4. How successful was the sampling design?
   - representativeness of the sample
   - response rate/possibility of non-response bias
   - weighting procedures
5. Sampling Errors
   - are confidence intervals reported for population estimates?
   - on how many respondents is each figure based?
6. When was the survey conducted?
   - time of year
   - interviewing on weekends - weekdays; afternoons - evenings?
7. Measurement
   - definition of recreation activity categories
   - time period for which data is requested
   - length of recall period
   - wording of questions
   - open or closed ended questions
   - question sequencing
8. Reporting of Results
   - Are methods clear enough so that you could replicate the study?
   - Are non-sampling errors discussed?
   - Are study limitations discussed?

and when the system under study is reasonably stable.

Even in trend extension, one must consciously or unconsciously make assumptions. Figure 4 illustrates several distinct projections based upon observations from three time periods. With data for only three previous years, assumptions of a linear, exponential or logistic (S-shaped) growth pattern all seem reasonable. These different assumptions yield quite different projections. Selection of the form of the equation must be based upon logical as well as statistical considerations. Do we expect the trend to exhibit a linear, exponential, or logistic growth pattern during the years for which we are projecting? Too often linear models are selected based upon statistical convenience or ignorance of alternative growth curves.

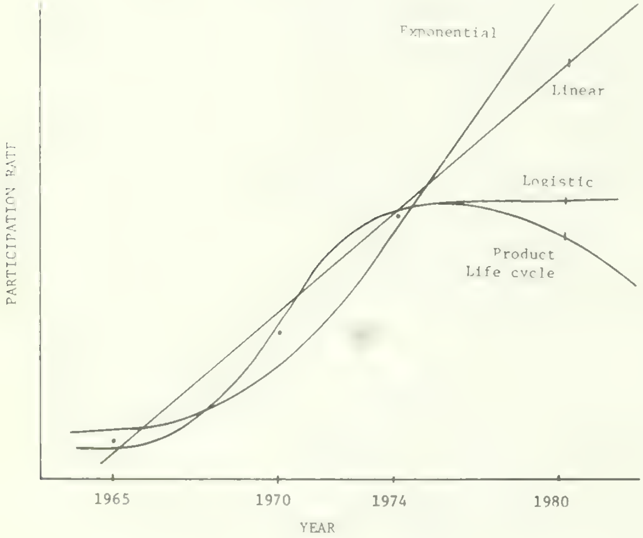


Figure 4. Trend Extension - Alternative Growth Equations

In fact, very few processes grow linearly. Logistic and exponential growth are much more characteristic of population and diffusion processes. Product life cycle curves often exhibit logistic patterns of growth, usually with a decline towards the end of the life cycle. We expect the adoption of outdoor recreation activities to exhibit similar patterns of growth.

The advantage of trend extension methods is their simplicity. However, these methods do not address the underlying forces that are producing the trend. Clearly an understanding of these forces should result in much better and much more useful forecasts, especially within a changing environment.

Structural Forecasting Models

More complex models are generally required to forecast further than five years into the future. In this case the assumption that the pattern of causal forces behind the trend remains unchanged no longer holds and an understanding of these forces becomes an important component of the forecasting model.

The most widely applied outdoor recreation forecasting model (other than seat of the pants) is the two step linear regression technique. The method was applied in the ORRRC studies (Report #26) and has subsequently been refined and further expounded by Cicchetti (1973) among others.

For a person with a given set of characteristics and recreation opportunities his or her probability of participating in a given recreation activity is estimated in the first step. Then in the second step the frequency of participation is estimated for those who participate. Both steps employ linear regression techniques to estimate coefficients in an equation of the form:

$$y = f(\text{socioeconomic characteristics, recreation opportunities,...})$$

where y is the probability of participating in the first equation and the frequency of participation in the second. Recreation survey data is used to statistically estimate the model parameters and the resulting equations are applied to forecasts of each independent variable in order to forecast future participation.

The independent variables are selected based upon their influence on participation and the ease with which they may be measured and forecasted. Age, income, and gender have proven to be the best predictors of outdoor recreation participation in such models. These variables are convenient for forecasting since predictions of future age-sex structures, and income levels are generally available. More recent applications have incorporated supply and price variables, although measurement and forecasting of these variables are more problematic.

The merits of these models, their problems, and the underlying assumptions will be discussed using the ORRRC projections as an example.

Although accuracy should not be our prime criterion for judging forecasts[4], the evaluation of how close these forecasts come to predicting 1976 participation rates will shed some light on the two-step linear forecasting model.

Evaluation of the 1976 ORRRC Projections

Brown and Hustin (1979) evaluated the ORRRC projections by comparing them with participation rates measured in the 1976 HCRS national telephone survey. A comparison of projected versus measured participation rates finds that the ORRRC study grossly underestimated participation in virtually all activities. For many activities the measured 1976 participation rate is more than double the rate projected by ORRRC (Table 4).

Table 4. [illegible] to Participate [illegible] Participating in 1976 Survey.

Activity	Projected by [illegible][1]	Participating in 1976 Survey	z score[2]
Driving for pleasure	56%	69%	28.68
Swimming	55	70	31.38
Walking for pleasure	37	65	67.51
Sightseeing	47	62	32.76
Picnicking	57	73	33.45
Fishing	32	55	51.33
Bicycling	11	47	122.[illegible]
Attending outdoor sports events	27	61	81.26
Boating (not canoeing or sailing)	28	35	15.73
Nature walks	16	49	95.[illegible]
Hunting	14	20	18.23
Camping	11	37	88.67
Horseback riding	6	1	27.59
Water skiing	9	17	[illegible]
Hiking	8	28	78.15
Attending outdoor concerts, plays, etc.	12	40	90.89

[1] From ORRRC Study Report 26, pg. 27.

[2] Normal approximation of a binomial proportion, corrected for continuity (Snedecor and Cochran, 1973). The null hypothesis of equal proportions projected vs. surveyed can be rejected for p ≤ [illegible]

SOURCE: Brown and Hustin (1979)

The ORRRC projection model was based upon six independent variables: (1) income, (2) education, (3) occupation, (4) age-sex, (5) urban-rural residence, and (6) leisure time. Relationships between participation in each activity and the six variables were estimated based upon a 1960-61 survey of outdoor recreation participation. A linear model was assumed.

Projections to 1976 were then made for each of the six independent variables and the model was applied to these projections to derive the 1976 estimates of participation for each activity.

Three types of errors are involved in this forecasting process.

1. Measurement, sampling and other errors in the 1960 and 1976 surveys.
2. Errors in the forecasts of the independent variables.
3. Model specification errors.

The accuracy of a forecast always depends upon the accuracy of base period fugures (1960 in this case). It should be noted that the model parameters were determined solely from a single survey conducted in 1960-61. This survey is subject to measurement and sampling errors. In evaluating the accuracy of the forecast, we also assume that the participation rates measured in the 1976 HCRS survey are accurate.

A more subtle difference between the 1960 and 1976 surveys is easily overlooked. The ORRRC projections are based upon a survey of activity between June and August 1960. Projections are therefore participation rates for the summer months of 1976. The 1976 HCRS survey measured participation over the entire year. It is not possible to separate out the summer months and hence any comparison of the ORRRC projections and the 1976 survey must be based upon assumptions about differences between summer and year-round participation rates.

We should expect summer rates of participation (i.e. the proportion of the population participating at least once during that period) to be less than year-round participation rates. The magnitude of these differences will be greater for activities with substantial non-summer use (eg. fishing and hiking) and relatively insignificant for predominantly summer activities like swimming and boating. In the following we assume no difference between summer and year-round participation rates.

The second source of error is in the projections of each independent variable. Comparing the ORRRC projections of these variables with actual estimates for 1976 reveals that income, education, occupation, and age-sex distributions were projected fairly accurately. No comparable 1976 estimates are available for residence or leisure time, making the projections somewhat suspect.

Model specification errors are the most serious in this case. A principal assumption of the two step method is that the relationship between the explanatory variables and

---

[4] Forecasts should be judged on their usefulness in decisionmaking, not their accuracy (Martino 1972).

participation, as estimated from 1960 data, continues to hold in 1976. Specifically, this assumes constant participation rates by demographic segments over time. Any change in participation rates predicted by the model must be due solely to changes in the explanatory variables. The increasing participation of women in many outdoor recreation activities (Bevins 1979) is one example of a direct contradiction to the model assumptions.

Model formulations that include supply and price variables are an improvement, but introduce additional measurement problems. The linearity of the relationship might be questioned, but logit and probit forms of the participation equation do not yield much improvement (Smith and Munley 1978). The use of these types of models for forecasting involves six common problems.

(1) A failure to include substitution effects. Separate and independent equations are generally developed for each outdoor recreation activity. A few of the models that include a price variable also include prices of close substitutes or complements, but these are rare (Talhelm 1973). Recent research into substitution among outdoor recreation activities does not yet provide much help for forecasters.

(2) Difficulty of incorporating supply factors. One's likelihood of participating in a given recreation activity is clearly related to the quality, quantity and price of available opportunities. Cicchetti (1969) and Beaman (1976) discuss the inclusion of supply variables and the accompanying problems.

(3) Reliance on cross-sectional data. Cross-sectional surveys are clearly not the best way to measure change or the forces producing change. Projecting 16 years into the future based upon observations during a single year is clearly suspect. Brown and Wilkins (1975) demonstrate that more accurate forecasts can be developed using structural models estimated from time series data, when this data is consistent and accurate and corresponding time series data is available for the explanatory variables. Unfortunately such data rarely exists.

(4) Other missing explanatory variables. The identification of explanatory variables continues to be a subject for research. For long-term forecasting a variety of social and economic variables seem relevant. Changing value systems, energy policies, family structures, and leisure time patterns are seldom included in recreation forecasting models. West (1977) suggests the addition of variables related to fad and fashion in leisure activity.

(5) Aggregation problems. Selecting the appropriate aggregation level continues to trouble recreation planners and forecasters. Regression models are generally estimated using data about individuals and then applied to aggregate populations. The ORRRC and most other similar projections apply the resulting equations to forecasts of the means of the explanatory variables.

The participation rate of a person with average income, average age, and an average amount of leisure time will not necessarily be a good estimate of the participation rate of the population as a whole. A more valid technique is to develop rates of participation for various population subgroups and apply these to the forecasted numbers of people within each subgroup. This requires future distributions of the population over all explanatory variables rather than just the projected population means for each.

(6) Statistical rather than process models. The structural models developed to date are for the most part statistical rather than process models. They do not capture the underlying decision processes that determine outdoor recreation participation. An individual clearly does not take a weighted sum of his income, age, occupation, and leisure time in deciding whether or not to participate in an activity. These models therefore yield little incite into the dynamics of outdoor recreation participation decisions.

Systems and simulation techniques are better suited to the identification of feedback effects, timelags and other dynamic characteristics of recreation systems. An examination of activity adoption, participation, and dropout decisions in the light of changing family structures and recreation opportunities might yield a better understanding of the dynamics of recreation participation. Models relating participation to equipment sales also seem promising.

CONCLUSIONS

The stimulus for this paper was the question of whether outdoor recreation participation data collected in the past is indicative of trends or merely reflects differences in data collection methods. We must conclude that some data series indicate changing patterns of participation and others are the result of measurement errors or methodological differences. The problem is that the task of telling which is which is not an easy one, and in many cases is impossible.

Those attempting to divine trend information from published research must exercise considerable caution. An understanding of data collection methods and an ability and willingness to dig into documentation of survey results in order to evaluate the quality and applicability of the findings is advised. Better data collection techniques and documentation of results are also needed.

Multiple sources of trend data should be sought and compared before drawing conclusions. Consistency and comparability of findings from different sources increases our confidence in the conclusions. This is especially true when distinct methods independently yield similar results.

Many of our recommendations for improving data collection, trend measurement and forecasting have been made before. The need for more consistent and comparable data collection efforts over time is clear. Before this can happen the importance and utility of trend information and forecasts must be recognized. There have been few systematic efforts to collect outdoor recreation data for the purpose of identifying trends. Available data has been collected primarily for other purposes. The data requirements for trend identification and forecasting are somewhat unique. Unless data is collected for these purposes the chances are that it will be inadequate or useless for forecasting.

Given the costs of data collection and the vast amount of trend data that might be collected, a systematic examination of trend information needs is required. This must be based upon an identification of the kinds of planning decisions that trend information might contribute to, and an assessment of the ikely improvement in planning decisions as ompared with the costs of data collection. nstitutional frameworks must be established o ensure periodic and systematic collection f the data and to develop appropriate infor-ation systems to facilitate its wise use.

Research is also needed: (1) to develop lear standard definitions of recreation erms, (2) to improve measurement techniques nd develop acceptable measures for variables hat are difficult to quantify, (3) to identify ariables that may help explain changes within utdoor recreation, and (4) to experiment ith forecasting models that more fully capture he processes that are taking place within utdoor recreation.

LITERATURE CITED

eaman, J. 1976. Statistical Projections That Go Beyond Projections of Past Trends. Canadian Outdoor Recreation Demand Study. Technical Note 13. Ontario Research Council on Leisure. Toronto.

Bevins, Malcolm I., Tommy L. Brown, Gerald L. Cole, Kenneth J. Hock, Marvin W. Kottke, Wilbur F. LaPage, Richard W. Stammer, and Daniel J. Stynes. 1979. Changing Patterns of Outdoor Recreation Participation in Northeastern United States. Northeast Regional Research Publication. Delaware Agricultural Experiment Station. Newark.

Bevins, Malcolm I. and Daniel P. Wilcox. 1979. Evaluation of Nationwide Outdoor Recreation Participation Surveys, 1959-1978. Vermont Agricultural Experiment Station. Burlington.

Brown, Tommy L. and K.L. Hustin. 1978. Evaluation of the 1976 ORRRC Projections. Unpublished Report. Department of Natural Resources, Cornell University. Ithaca.

Brown, Tommy L. and Bruce T. Wilkins. 1975. Methods of Improving Recreation Projections. Journal of Leisure Research 7(3):225-234.

Cicchetti, C.J., J.H. Seneca, and P. Davidson. 1969. The Demand and Supply of Outdoor Recreation. Bureau of Economic Research. New Brunswick, NJ.

Cicchetti, C.J. 1973. Forecasting Recreation in the United States. D.C. Heath. Lexington, Mass.

Martino, Joseph P. 1972. Technological Forecasting for Decisionmaking. American Elsevier. New York.

Mendell, Jay. 1969. There is no such thing as NOT forecasting. The Futurist (Dec.): 161.

Moeller, George H. and Herbert E. Echelberger. 1974. Approaches to Forecasting Recreation Consumption. Outdoor Recreation Research; Applying the Results. U.S. Department of Agriculture Forest Service General Technical Report NC-9. St. Paul, Minn.

Outdoor Recreation Resources Review Commission. 1962. Prospective Demand for Outdoor Recreation. Study Report 26. U.S. Government Printing Office. Washington, D.C.

_____________. 1962. National Recreation Survey. Study Report 19. U.S. Government Printing Office. Washington, D.C.

Smith, V. Kerry and Vincent G. Munley. 1978. The Relative Performance of Various Estimators of Recreation Participation Equations. Journal of Leisure Research 10(3):165-176.

Stynes, Daniel J. 1979. A Comparison of the 1977 National Telephone Survey with a Northeastern Regional Survey of Outdoor Recreation Participation. Unpublished Report. Department of Park and Recreation Resources. Michigan State University. East Lansing.

Talhelm, Daniel. 1973. Economic Evaluations of Sport Fishing in Michigan: A Comparison of Methods and their Application. Paper presented at American Agricultural Economics Association meeting. Edmonton, Alberta.

U.S. Department of the Interior, Heritage Conservation and Recreation Service. 1978. 1977 National Telephone Survey. Unpublished Report. Washington, D.C.

West, Patrick C. 1977. A Status Group Dynamics Approach to Predicting Participation Rates in Regional Recreation Demand Studies. Land Economics 53(2):196-211.

Wheelwright, Steven C. and Spyros Makridakis. 1973. Forecasting Methods for Management. John Wiley and Sons. New York.

THE TREND OF MEASURING PUBLIC USE OF THE NATIONAL PARKS[1]

Kenneth E. Hornback, Ph.D[2]

INTRODUCTION

Since the outburst of interest in outdoor recreation travel in the period following World War II, measurements of outdoor recreation have been made in many ways. The measurement of outdoor recreation is decentralized activity being carried out by a large number of private and federal agencies with a variety of goals and purposes. Future improvements in federal statistics will partially come from the emergence of a combined strategy for statistical data gathering. Partially due to decentralization, such a strategy has not emerged even though the need for trend data is wide-spread. To envision the characteristics of a more coordinated and cost effective program of outdoor recreation measurement, it is helpful to consider the history of outdoor recreation studies. Changes in studies conducted for the National Park Service (NPS) illustrate a trend with several periods.

Travel and Tourism Studies

From the early 50's to the early 60's, the Federal Highway Administration (FHA) engaged in cooperative programs with state highway departments to collect specific measurements of travel and tourism activity. The primary concerns of these studies were to gather basic data for economic and highway planning. Major national parks were sites for many of these studies.

Because of the relatively narrow applications intended for these studies, the scope of inquiry was limited to a few basic issues. The information collected usually included vehicle type, home town, trip purpose, trip mileage, overnight stays, duration of stay, and trip expenditures. As a result of the narrowness of focus, the comparability between travel studies is surprisingly high.

These travel and tourist studies used entrance station interviews or mailback questionnaires. The brief sets of questions could be completed by the visitor in a few minutes. Appendix A contains information about how field operations were carried out (Cape Cod study of 1963). Appendix B shows several questionnaires used in the Grand Canyon Tourism Study (1953). Several of the studies used identical interview schedules (Grand Canyon and Yosemite studies in 1953).

The findings of the travel and tourism studies were generally reported as descriptive statistics in various tables and figures. The focus was on the market area served by a particular park, the forecast of future use which could be expected from that market area, and the economic benefits of visitation to surrounding areas. The reports vary in quality and tend to assume that the usefulness of the results is self-evident. Descriptive findings are typically presented with expressions like "it is of interest that". . . "interesting to note", and "as reasonably could be expected. . ." (Shenandoah Travel Study, 1952). There is no record of any raw data ever being centrally stored for later use although in one case findings were compared to eight other travel studies (the 1963 Cape Cod survey).

---

[1] Prepared for publication in the proceedings of the Outdoor Recreation Trends Symposium, April, 1980, Durham, N.H. Forest Service, Department of Agriculture.

The views expressed here are those of the author alone. These views are not official policy of the National Park Service and do not involve material approved by any office of the Department of Interior. I would like to acknowledge the helpful reviews provided by Dr. Don Field, Pacific Northwest Region Chief Scientist, NPS, and Dr. William Key, Consultant to the Chief Scientist, NPS, Washington.

[2] Kenneth E. Hornback, Ph.D Chief, Statistical Office, U.S. Dept. of Interior, National Park Service, Denver.

The travel and tourism studies reflect several advantages and disadvantages of measuring outdoor recreation. Advantages included the narrow focus, general comparability between studies, cost effectiveness of acquiring data, and the use of client participation in the collection effort (FHA funds enabled State highway departments to collect data or hire local people to do the work). Disadvantages included the failure to provide for the common storage of raw data and the failure to document applications of data to planning and management problems. These studies were one-shot studies and were not concerned with the problem of learning about trends.

Travel and tourism studies received lower priority beginning in the early 60's. As planning for the inter-state highway system neared completion, the work of the FHA concentrated more on the problems of urban area transportation planning. But as this particular type of study declined in frequency, a new type of study began to appear.

Visitor Use Studies

The study of travel and tourism had many beneficial effects for the NPS. Among the benefits was the interest stimulated in the visitor as a factor to be treated in both planning and management. The benefit, however, did not come directly from the original travel and tourism studies but from the great variety of "visitor use studies" which were sponsored by diverse interest from many different parts of the agency. These studies tended to be exploratory and responsive to the new curiosity of park staff about the visitor, visitor attitudes and behavior. The visitor use study appeared in several distinct forms.

The user satisfaction study was conducted to gather information needed to evaluate interpretive programs and to gather basic performance data on how well the park was doing its job. These studies often concentrated on the things which visitors liked, found useful, or judged to be of value to them. To the extent that they focused on manageable conditions, these studies discovered that people were more satisfied when the litter was controlled and the trails and facilities were maintained. Often, however, the focus of these studies was vague and they often identified circumstances which were beyond the realm of manageable conditions, e.g. campers were satisfied when other campers were pleasant to be around. Such studies often attempted to measure the perception of environmental quality or determine the meaning of the visiting experience. To this extent, indicators were developed to capture differences in the expressions of feelings, experiences, and perceptions. These types of studies did not lend themselves to comparison because they used a great variety of definitions, concepts, and methods of measurement.

Closely related to the "satisfaction" type of study was the attempt to measure sociological "carrying capacity." Emerging in the early seventies, these studies attempted to parallel natural science studies of resource wear and tear. The sociological measurement problem was to determine when visitor density itself prompts changes in the quality of the visiting experience. These studies were plagued by a variety of confounding conceptual, theoretical, and operational problems. Some visitors, for example, valued having others around while others wanted to avoid people. The "sociological carrying capacity" type of study, however, did serve to sensitize managers to the varying needs of user groups.

The "visitor profile" was yet another form of visitor use study. Characterized by their taxonomic style, these studies grouped people according to various types or styles of behavior, e.g. backcountry users, straight and counter-culture users, family users, etc. These studies served to refine statistical generalizations such as emerged from the tourism studies by demonstrating that while the "average visitor" did not exist, there are patterns of behavior that distinguish people from one another in ways that bear on management actions. The focus on differences between visitors is important because it suggests that there can be corresponding differences in management actions. Such studies, for example, contributed to thinking about ways to control potential conflict among visitors by zoning activities. Knowledge of seasonal changes in types of visitors enabled changes to be made in the content of interpretive programs.

One of the most distinctive types of visitor study was the regional, interagency transportation study. These studies attempted to bring the accumulation of many earlier styles of inquiry to bear on outdoor recreation behavior at one time. While few of these were completed (Great Smoky Mountain National Park study in 1975 and Yellowstone-Teton National Park in 1978), they played a key role in the spread of interest in the visitor and impacts of visitation on parks and the surrounding communities.

However, because of the broad focus, the large variety of participants, and wide areas of geographic interest, the volume of survey data collected by these studies grew to enormous proportions. In contrast to the brief tourism studies, the regional visitor use studies pursued answers to scores of questions ranging from general recreational activities to social attitudes. A major result of this type of study was the sensitivity it created about cost effectiveness (time and monetary cost to the agency as well as reporting burden on the participating public). It seemed evident that if information about the public as a consumer group was to be applied routinely to national park management, it would have to be timely and through a more limited, cost effective method.

Throughout the sixties and into the mid-seventies, various forms of visitor use studies have been conducted on behalf of the NPS. Throughout this period, unfortunately, an integrated body of organized knowledge failed to emerge even though great effort was invested in the task. If anything, the great diversity of effort suggested the need for establishing some centralizing control to insure economy of effort.

Research Studies

The proliferation of ad hoc studies during the 60's served to bring the need for a more systematic program of studying the visitor and visitor behavior to the attention of NPS management. In the early 70's, efforts were completed to establish several regional centers of social-scientific research in the NPS.

The Cooperative Park Studies Units were created at various universities for the purpose of blending the intellectual power of academia with the apparently intractable difficulties of resource management.

Centralizing the expertise for social science work served a variety of purposes. At last there were places where consultation could be acquired, where research coordination could be made, where quality control over study design could be exercised, and where findings and raw data could be assembled for later use. The institutional formalization of social science activity prompted greater research coordination and indirectly contributed to the assembly of interdisciplinary perspectives. These centers served as a focus of communication between the academic and governmental communities and achieved some degree of reorientation of effort for their mutual benefit. In addition, the monumental task of inter-agency coordination was carried out by these centers, eliminating some redundancy and improving the transfer of social science technology to NPS management at minimal cost, e.g. the computerized backcountry permit system developed by the Social Science Program in the Pacific Northwest Region, NPS.

Throughout the period of growing experience and mobilization of effort, however, a persistent problem served to confuse the establishment of more viable social science goals: who was to be served by the application of social science to management and planning, and how? Was the level of application to be at the site, within the region, or at the national level? Nowhere is the conflict of applications more evident than in various public opinion polls which were conducted.

Public Opinion Polls

This type of work differs from other visitor studies in that the population studied is the general rather than the visitor population. The methods, therefore, tended to be off site telephone and personal interviews. Such studies were needed because studies done for research purposes or on behalf of unit managers did not yield information needed about broader problems.

From 1968 to 1972 a variety of national and regional public opinion polls were designed and carried out for the purpose of expanding knowledge of participation in and opinions about outdoor recreation, a purpose which was not being served by other studies. From these studies valuable perspectives about the relationship between visitors and nonvisitors was gathered and made available to upper level management. In addition, a series of short "People in the Parks" reports were prepared to explain the general usefulness of the data to planners and managers. Theoretically, information would "filter down" until it found an application. The reports were propagated because they "may also be useful to other divisions for any number of purposes. . . How it may be useful to each division will, of necessity, be decided within the division."

Unfortunately the expected integration of general survey findings into planning and management documents did not spontaneously happen, possibly because there were no experienced social scientists available to help other professionals find the meaning of general findings for specific actions. On the other hand, social scientists themselves may not have had sufficient experience in the work of planning and resource management. Although much effort was put into the task of delivering findings to other professional groups, social scientists often stopped short of saying exactly how information was to be used.

Discussion

The preceding account of studies done for the National Park Service represents one viewpoint on how social science work was carried out and what was accomplished over the years. While many subjects have been explored and a variety of study tactics have been tried, the cumulative impact of the findings on planning and management is less than might have been expected judging by the effort (time and cost) invested. The failure to communicate better could be due to a variety of problems such as the delays necessary to accomplish the studies themselves, lack of general experience of scientists and planners in working together on managerial problems, the artificial "freezing" of data in the text of a written report, failure to focus on comparative and trend data, and mismatched expectations of what studies can and cannot do. While studies can make crucial impacts on thinking, study findings too often were applied cosmetically if at all.

Up to the present both the scientific and managerial communities have been learning about the role of social and economic data in natural resources management. While the period of learning is far from over, a period of applications needs to be started. The tactic of gathering data by studies may itself be a problem. While scientific studies will continue to be essential sources of new knowledge, studies may not represent the tools needed to effectively bring information to planners and managers. Other ways of gathering and communicating the use of information need to be explored.

The coming decade promises to bring revolutionary changes in the economy which will alter previous circumstances in which out-door recreation has occurred. The context of planning will soon be unlike what it has been in the past. The rate and degrees of change may be so fast and extreme that conventional studies will be inadequate to assemble required data for planning and management. In the future, natural resources planning and management will rely more heavily on limited programs to monitor public use and an improved system of federal statistical reporting about out-door recreation.

Monitoring Public Use

From the limitation of studies as a method of collecting information for park management, a complementary method was developed in the late seventies: continual monitoring of public use. While not an evolutionary step beyond the ad hoc study, continual monitoring serves purposes which cannot be as effectively served by conventional studies. While monitoring must be an activity which is restricted to collecting a few variables, the benefit of monitoring is that it yields comparable data on a continuing basis. The focus of monitoring is on change and, more importantly, comparative change. This is an important development in the effort to bring social science to bear on park planning and management because with this type of information it is possible to focus on the trends of public use and the question of what differences exist between types of areas, geographic locations, and forms of management.

The content of the current public use monitoring program under development by the NPS is limited to a few items which can be quickly gathered using a free-form interview schedule. Questions include (1) where people entered the park, (2) when they entered, (3) how often they come, (4) where they live, and (5) what other places they have visited on their trip. In addition, the visitor is asked "on your first day in the park, (6) where did you go, and (7) what did you do?" This last question is a general probe designed to recover the details of the visit using a notational coding method. For the purpose of reducing costs, this type of interview is designed to be conducted by members of the park staff who are specially trained by the NPS Statistical Office. Seasonal or permanent staff members gather the data in the context of their day-to-day contacts with visitors. The interviews serve to give visitors an opportunity to ask questions and give comments (both positive and negative) about their visit and to give park staff a systematic way to learn about the visitor and the pattern of park use. All data are carefully edited and errors are returned to the interviewer for training purposes.

The major source of cost effectiveness, however, is the entry of data into a data base management system (DBMS) which is accessed by conventional English commands (INQUIRE). The timeliness of data collection and editing creates a "live" foundation of statistical data for planning and management. Rather than prepare reports on findings, park service statisticians prepare a library of graphic and tabular outputs which is made available to clients of the system as needed (Computer Assisted Management Program - CAMP). Parks draw data interactively using conventional computer terminals. Use of the system and its application to various kinds of work are explored in "Applications Clinics" conducted at the parks by members of the agency statistical office.

One of the major limitations of the monitoring type of activity is the question about the quality of the data. If such programs are to be successful in terms of financial cost, they must take advantage of every opportunity to economize. Asking the unit manager to administrate the task with existing staff is a shortcut which eliminates one of the major expenses of this work. Although NPS field staff are not primarily assigned to conduct interviews, most have shown a genuine interest in gathering this kind of information. One of the major reasons for strong field support is the dedication of the monitoring effort to gather basic information commonly recognized as essential to routine park management. The availability of data within ten days of collection also serves to stimulate interest in the quality and utility of the findings. To the extent that active interest in the findings can be maintained by timely production of findings and to the extent that training and careful editing of data can be completed, the monitoring program can result in data of respectable quality for the purpose to which it is applied.

As the concept of monitoring as a tool of park administration spreads, more areas will be added to the system and comparative, aggregate, and time series studies will be conducted. As interest in data based management grows, new applications will be found. Program and policy evaluation will become easier and more timely as actions are reviewed for effects which are detected by the monitoring of public use.

By monitoring public use on a limited basis, the Park Service engages the active participation of visitors in the park management process. However, to insure the application of data to the largest number of managerial problems faced by the federal government, the data collected by the National Park Service needs to be a part of an integrated statistical effort.

Federal Statistical Policy and Outdoor Recreation Statistics

The current federal activity in out-door recreation measurement suffers from a variety of problems. Standardization of procedures and documentation of methods have not been fully completed. Training and quality control over field practices needs to be improved, particularly in areas where staff resources are minimal and conventional sampling is difficult to carry out. The frequency of "estimates" as a basis for determining certain figures is much greater than is desireable. At the same time, the breadth of the current statistical accounts (generally visitor hours and visits) is of slim utility for any sort of realistic planning and of little use for site management.

A major element of the problem is more or less common to all federal offices working with minor statistical programs. A situation of perpetual negative feedback tends to exist: (1) lack of resources (staff and money) requires shortcuts in statistical procedures; (2) shortcuts in statistical procedures lower validity and reliability of data; (3) data low in validity and reliability cannot be used to solve managerial problems; (4) data which do not solve problems do not receive priority for resources; (5) lack of resources. . . Although all agree that good public use data are essential to planning and management, the negative feedback cycle creates a situation which tends to maintain statistical systems at subsistence levels.

The problem, however, is widespread. In July, 1978, the U.S. Department of Commerce issued A Framework for Planning U.S. Federal Statistics, acknowledging the various problems of decentralization generally, and specifically the numerous difficulties of minor statistical programs such as the general efforts to measure trends of outdoor recreation.

It seems safe to predict that increases in resources for out-door recreation statistical programs will not change without improving the programs themselves. Fortunately, this can be done. To the extent that a voluntary division of labor is accepted by various agencies, the combined efforts to cover segments of outdoor recreation statistics can be made cost effective. In the past an agency might look into a problem and report certain findings which would have limited utility for or be at odds with the immediate objectives of another agency. The typical response is to launch an additional study/counter-study tendency is enormously costly. Redundancy of effort can be reduced if agency social science professionals guide their agencies toward better coordination. This requires, however, that the same professionals take greater interest in what is being done around them and act to influence the work of other agencies to adequately meet the needs of their parent agency as well.

The National Park Service's effort in this direction include both sharing data it produces and depending more on data produced by other participants in the measurement of out-door recreation. The U.S. Travel Data Center, for example, conducts monthly surveys of travel from a random sample of people in the nation which promises to yield valuable data which is not available elsewhere. Combined with the surveys of national recreation and travel conducted by the Heritage, Conservation, Recreation Service and the Bureau of Census, a formidable body of data for new area and existing site planning is available. National Park Service data are already shared with the Department of Commerce, Federal Highway Administration, and Department of Energy. Current planning work is especially sensitive to the need for information exchanges such as near areas where boundary land exist. Here again, the NPS Cooperative Park Studies Units at various universities have played a key role in improving interagency exchanges by easing the problems of information access. Ideally, creating better access to statistics at the federal and state level, including distribution to places of higher learning, will have a positive influence and will enable basic improvements to be made as higher demand justifies better support for programs to measure outdoor recreation.

Conclusion

Viewed as a series of changing tactics of measuring public use, outdoor recreation studies since WWII reflect a variety of accomplishments and shortcomings. Travel and tourism studies served to stimulate and broaden the interest of planners and managers for information about people. Visitor studies served to satisfy curiosity about a large variety of interesting questions ranging from visitor judgements to attitudes and opinions. Research studies brought methodical thinking to conceptual problems of measuring out-door recreation and sharpened the tools of study. In spite of obvious progress in the ability to contribute to planning and management, the actual adoption of public use data as a factor in planning and management has been limited. Until a better strategy for gathering data about out-door recreation can be developed, the desired impact of public use information on planning and management will not take place.

Studies may not be sufficient to communicate the applications of data to the problems of management and planning. An improved strategy will also involve the idea of continual monitoring of public use. The resulting statistics can be merged into a system which is both useful to the site manager and useful to the managerial concerns of those working at regional and national levels. Many improvements, however, need to be made in the quality of existing statistical programs. These improvements may be made without substantial additional investments if a productive voluntary division of labor can occur among agencies participating in the measurement of outdoor recreation.

These views are offered in the belief that important work has been accomplished but is undervalued. Suggestions are offered in spite of the liklihood that, here too, every solution has a problem.

LITERATURE

Although this paper has not involved direct references to other literature, the reader may have interest in related work. The following references are offered for those with continuing interest:

Buhyoff, Gregory J. 1979. Evaluation of Current Statistical Reporting Procedures and Recommended Corrective Action. Statistical Office, National Park Service, Denver, CO.

Carnie, Chere Amie. 1979. "Public Use Reporting in the National Wildlife Refuge System and Recommendations for Improvements". Unpublished mimeo. U.S. Fish and Wildlife Service, Division of Refuge Management Washington, D.C.

Duncan, Joseph. 1975. "Planning the Federal Statistical System--A Historical Perspective." A Numerator and Denominator for Change. Technical Paper 37, Department of Commerce, Bureau of Census.

Thoennes, Nancy A. and William H. Key. 1979. "Review of National Park Service Science Research". Unpublished mimeo. Department of Sociology, University of Denver, Denver, CO.

U.S. Department of Commerce, Office of Federal Statistical Policy and Standards. 1978. A Framework for Planning U.S. Federal Statistics for the 1980's. U.S. Government Printing Washington, D.C.

APPENDIX A

CAPE COD TOURIST STUDY

	COLUMN	CODE
1. Station	1	
2. Date	2-3	
3. Hour	4-5	
4. Vehicle - Sedan( ) Station Wagon( )		
Trailer - Camper( ) U-Haul( ) Boat( )	6	
5. State of Registration		
Mass.( ) R.I.( ) Conn.( ) N.Y.( )		
Other__________ (Specify)	7-8	
6. Car Occupancy		
Adults Male____ Female____		
Children under 16 Male____ Female____	9-14	
7. Where is your permanent residence?__________ (Town) ____ (State)	15-20	
If on the Cape / If not on the Cape		
(A) Do you have a summer residence on Cape Cod? Yes( ) No( )	21	
Where__________ (Town)	22-23	
(B) What is the purpose of your trip?		
Business and Pleasure ( )		
Personal Business ( )		
Shopping ( )		
Serve Passenger ( )		
Recreation ( )		
Vacation ( )		
Medical, Dental, Education, Church ( )		
Social ( )		
Work ( )		
Other__________ (Specify) ( )	24-25	
(C) When did you arrive on the Cape?______ (Mo.) ______ (Day) ______ (Time)	26-30	
If today / If prior to today		
(1) Where did you stay?__________ (Town)	31-32	
(2) At a motel( ) hotel( ) cottage( ) tent( ) private home( ) other______ (Specify)	33-34	
(D) What was the purpose of this trip?		
( )vacation, ( )recreation, ( )work, other______ (Specify)	35-36	
What was your major recreational activity?		
( )beach, ( )boat, ( )fish		
( )scenery ( )other__________	37-38	
(E) Is this a rented car? ( )Yes ( )No	39	
(F) Now for my last question, approximately how much did you spend on the Cape? $__________	40-43	

The questionnaires were filled in by the interviewers and coded later in the office. 17,404 vehicles were interviewed out of 62,312, an overall sample of 28.4 percent. In addition to serving the requirements of the study, the stations were selected to insure the safety of the motorists and the interviewers. Wherever possible, sites were so chosen that interviews could be conducted off the road. One station was located at a rest stop. When the interview was completed, each driver received a formal note of thanks explaining the reason for the interview.

APPENDIX B

GRAND CANYON NATIONAL PARK TRAVEL SURVEY

1. Auto
2. Bus
3. Truck
4. Motorcycle

A. Residence:
   1. City or Town______________________ State ________________
   2. State of Vehicle Registration______________________________
B. Is this trip for: 1.Pleasure___ 2.Business___ 3.Both___________
C. Was your trip to the Grand Canyon the principal purpose for your trip from home? Yes___ No___
D. How many persons in your party?
   (Don't forget the babies and other children)___________________
E. Where were your last two overnight stopping places before entering the Park? If more than one night in either place, then, please write the number of nights:
   a. Last Night____
   b. Night Before____
   c. What type of accommodations did you use during these stops?
      1.Hotel___ 2.Auto Court(Motel)___ 3.Trailer Park____________
      4.Camping___ 5.Friends or Relatives___ 6.Home_______________
      7.Other (Specify)____
F. Overnight stops while in the Park:
   a. How many nights did you stay in the following accommodations?
      1.Hotel___ 2.Cabin with Bath___ 3.Cabin without Bath________
      4.Camping___ 5.House Trailer___ 6.Other (Specify)___________
   b. CIRCLE your first preference above, if type desired was not available.
   c. If you are not stopping overnight, are you leaving the Park because accommodations were not available? Yes___ No________
G. For the ENTIRE TRIP, please estimate:
   a. How many days will you be gone from home? __________________
   b. How many miles will you travel on the entire trip? __________
   c. How much will you spend on your entire trip? _______________
H. For that portion of your trip in Arizona, please estimate:
   a. How many days will you stay in Arizona? ____________________
   b. How much will you spend in Arizona? _______________________
I. During your stay in the Park and while enroute to and from the Park, please estimate how much you and the members of your party will spend in this GENERAL VICINITY for the items listed below: (Outer limits of this "general vicinity" includes such places as Prescott, Ashfork, Williams, Flagstaff, Cameron, St. George, Cedar City and Panguitch)

(NOTE: Include Credit Card Purchases)	TO NEAREST DOLLAR
Food	$_______________
Lodging	$_______________
Gas and Oil or Transportation	$_______________
Other(Park Entrance Fee,souvenirs,etc.)	$_______________
TOTAL	$_______________

J. Where do you plan to make your next overnight stopping place after leaving the Park? No. of days
   a. Town and State______________________this stop_____________
   b. Please check the type of accommodations you expect to use:
      1.Hotel___ 2.Auto Court(Motel)___ 3.Camping___
      4.Trailer Park___ 5.Friends or Relatives___
      6.Home___ 7.Other (Specify)_______________________________

K. Show order of preference with a 1, 2, 3, for the THREE features which appealed to you most in the Park:
   a. Enjoyment of Scenery_______
   b. Mule trip into Canyon______
   c. Climate____________________
   d. Hiking ____________________
   e. Camping____________________
   f. Horseback Riding___________
   g. Ranger Talks_______________
   h. Indian Dances______________
   i. Wild Life _________________
   j. Evening Entertainment______
   k. Other Attractions (Specify)______________________________

L. Have you visited or do you plan to visit the other Rim of the Grand Canyon on this trip? Yes___ No___

COMMENTS OR SUGGESTIONS REGARDING YOUR VISIT TO THE PARK WILL BE APPRECIATED: ____

____

____

____

____

____

____

DATA BANKS FOR RECREATION SUPPLY AND PARTICIPATION[1]

E. M. Avedon & S. L. J. Smith[2]

Data archives and data banks have become increasingly important as more researchers begin to examine trends. Characteristics of data banks, sources of bias in secondary data sources and important trends in data banks are described. The paper concludes with advice about using data banks.

INTRODUCTION

Studying outdoor recreation trends presumes a source of historical information upon which description and forecast of trends can be based. In the past, forecasters relied on private sources of data, on access to private and public agency records, and on published tables and statistical documents archived in research libraries for these purposes. A relatively new source of information (primarily but not exclusively quantitative) has become more accessible to recreation researchers in the last decade, namely, machine readable data and data archives.

Since World War II, the social sciences have undergone an "information explosion". This explosion is usually evidenced by the dramatic growth in the publication of books and journals. As great as this growth has been, it does not tell the full story. The social sciences, like the physical sciences have become more quantitative, and behind every scientific publication in the social sciences there are quantitative findings upon which the report is based. However, in the social sciences more data are often collected than ever find their way into published reports. This is common practice in many contemporary surveys and historical studies. In fact, many elaborate and costly primary data gathering projects are undertaken without a clear plan for analysis of all data collected in the project.

In the past, such "excess data" would have been destroyed, but today such "excess data" represent a valuable storehouse for future research and planning and policy analyses. Information is stored without analysis or interpretation on punched cards, magnetic cards, paper tape, magnetic disk, magnetic tape, microfilm, and other mechanical or electronic media to facilitate retrieval. Unlike information stored in published form, such as the familiar printed tables of a national census, emphasis in a data archive is on rapid retrieval, custom rearrangement, processing, and summarization. Such flexibility is a boon to the myriad of potential users of any data set. Academics planners, management consultants, entrepreneurs and others can examine and use the same data set for widely differing purposes with equal ease. Although there may be different missions and policies in different machine readable data archives, and although information may vary from bank to bank, usually a data bank does not direct or control the types of information a user seeks. The secret of success and usefulness of data banks, if there is a secret, is to emphasize technology over teleology.

The concept of a data bank took hold in many facets of industrial society over the past thirty years. Airline reservations systems, department store accounting records, warehouse inventories, banking statements -- are just a few well known examples of this phenomenon. However, industrial and commercial data banks are designed for single-purpose use, by highly trained users, based upon rigidly efficient and economic systems. Within the social sciences, it was recognized that data have multiple research uses, and although some potential users may be skilled methodologists, many are relatively unsophisticated users - particularly in academic settings. Thus social science data banks could not be designed as a single purpose entity, but rather had to be designed as "banks" with multiple functions. Furthermore, data elements destined for industrial and commercial data banks were collected and prepared within the objectives of their single purpose systems. Social science data on the other hand continues to be generated through a variety of sources, and each source has its own research "perspective".

---

[1] Presented by Dr. Smith at: OUTDOOR RECREATION TRENDS - A NATIONAL SYMPOSIUM, Elliott Alumni Centre, University of New Hampshire, April 20-23, 1980.

[2] Authors are Director and Research Associate, respectively, of the Leisure Studies Data Bank/Banque de Donnees sur les Loisirs, University of Waterloo, Waterloo, Ontario, Canada.

Data banks developed as a practical response to the need to handle a flood of information. One major contributor to this was the rapid development and expansion of computer technology. Social science data in the 1950's and 1960's paradoxically rendered the information generally irretrievable to the unaided researcher. To overcome this, scholars and decision-makers began to cooperate to pool information resources. They found, however, that such a project easily became time-consuming, costly, and involved great practical difficulties. If an individual did not have personal knowledge of a particular information source, the research literature often had to be scanned to track down possible sources. Once the required source of the data had been identified, it was necessary to determine if these data were still in existence, and how accessible they were to the researcher's computing resources. Often it was found that the source had not been sensitive to the possibilities of further analysis on the data collected, and as a consequence, took no pains to store the information in a manner as to allow universal retrieval and re-use.

When such data were available, they were often stored in an idiosyncratic fashion, accessible only to the source, and after a while, not comprehensible even to the source. Coding may have been ambiguous, or worse, undocumented, rendering the data useless. Formats, definitions, and terminology often reflected local, arbitrary conventions. Data documentation might contain mis-codes, missing records, and labels in a foreign language. To clarify, clean, and edit these records required more time, money, and technical expertise and sophistication than most individual researchers have. It became evident, not just to individuals, but also to universities, governments, and other agencies that retaining archivists and related personnel would be necessary to acquire, prepare, store, and retrieve machine readable social science data on a continuing basis. This recognition led to the establishment of the specialized data banks for the social sciences that exist throughout the industrialized world.

Characteristics of Data Banks

The parallel between data banks and research libraries is obvious, but there is a divergence more important than any similarities. Data banks do not attempt to archive all available information related to their specific mission. Each bank has some identified theme, and collects data in keeping with that theme. Sources of information are diverse, to the point that an "outsider" may not immediately recognize the relevance of a particular data set to the archive's mission. For example, the Leisure Studies Data Bank at the University of Waterloo primarily acquires machine readable data concerning leisure-related phenomena. This perspective normally includes survey and administrative data regarding facility or resource use, expenditures, tourist origin and destination information, performing arts audience information, park attendence information, and the like. Some information is donated by expected sources, such as the Ontario Ministry of Culture and Recreation, but data are also sought from less obvious sources such as the Federal Ministry of State for Science and Technology. In this example, we obtained a survey of the impacts of science on Canadians that included useful information about attitudes toward television viewing. Another social science data bank may acquire data only regarding political attitudes, such as the Roper or Gallup poll data, and the extent of leisure-related information in that data bank would be minimal. Some data banks acquire data for specific geo-political areas only, rather than for a specific theme. When the holdings of a bank are examined, new perspectives on both themes and data sources are possible. Collecting information on different aspects of leisure not only creates new perspectives and research possibilities, it creates a collection of skilled personnel. Data banks become the loci for contacts among people trained in data collection, data management, and data analysis. Exchanges among technicians, scholars, and policy-makers provides a rich environment for all. A data bank is more than just a warehouse of numeric information, it is a source of assistance, insight, and inspiration for the researcher.

Data are initially obtained in a variety of forms and structures, from simple tabular reports through decks of standard punch cards, complex multi-punched formats to edited and labeled variable spanned matrix system files. Most banks in archiving a data file, store information in a single medium (commonly magnetic tape), that can be read easily and worked efficiently. Generally, data banks do not place restrictions of the size of a data set that can be archived, and although most data sets are of a manageable size for research or re-analysis, storage can become a problem when a collection grows large. Large data sets are more often a processing problem for the researcher, than an archiving problem for a data bank. Tape storage is usually in a central computer tape library under climate control and access is protected by a stringent security system. The former is to prevent physical decomposition of the tapes, the latter to prevent unauthorized use of a data file, or the inadvertent destruction of a file by an unsophisticated user. Because data are machine readable, physical distance from the tapes, or for that matter from the computer, is not a problem. Access is accomplished through electronic communication, and all a user needs is a small computer terminal, a communication link, and a telephone number. For example, although we are hundreds of miles from the Leisure Studies Data Bank -- with a terminal, a coupler, and a telephone we could access and process any of the Bank's holdings from this room! This is not unusual. At the Central Social Science Archive at the University of Cologne, users are in a building on the campus in Cologne, but the computers and the tapes are in the city of Bonn, kilometers away. At the University of Odense at the Danish Data Archive, on the island of Fyn, one of their computers and its adjacent tape library is on the island of Zeeland, in a town north of Copenhagen. At this time many researchers have access to a network of information from a number of data banks, and such practice is becoming easier as technology is developed.

Although stored numeric data form the heart of a data bank, these would be useless without supplementary documentation which explains, for example, that the fourth through the ninth columns in each record gives the total population of a region; or that specific concentrations of magnetic oxides at a certain location on a tape indicates that information concerns swimming. Documentation may be in print or may also be machine readable. In fact, the latter is becoming more common place to permit greater access to data by users from a distant terminal.

At a minimum, documentation provides the following types of information:

1. description of data structure;
2. description of data format;
3. examples of both structure and format;
4. size of data set;
5. definitions of data elements;
6. explanation of abbreviations and codes used;
7. description of sampling design and technique, substitution procedures, etc.;
8. non-response rates and weighting procedures
9. source statements that generated data, instrumentation, tests;
10. bibliographic citations for publications based on use of the data set;
11. list of related data sets;
12. names and addresses of personnel or the agency responsible for collecting the data;
13. special information regarding access or processing.

To provide data and documentation to users, data bank staff members are called upon to perform a variety of tasks. They must provide enough information about the availability and contents of holdings and how to retrieve the required data set. Behind these obvious tasks are many hours of effort that are invisible to the user. The process of archiving a data set so that it can be used has become a highly technical and exacting skill. As a bank gains visibility and its staff matures, they are expected to serve as consultants to potential users not only with respect to retrieval of data sets they have archived, but with respect to computer software, statistical procedures, and eventually even research design. In time, they are called upon to make recommendations about the process of primary data collection and storage for eventual deposit in a data archive.

Sources of Potential Bias

Because of the wealth of data available, and the pressure on archival staff to provide ever greater detailed and technical advice, data banks specialize and refine their official mission. Specialization produces an inherent bias through the type of data available, who donates data to a bank, and who would likely use a bank. Although "leisure" as a subject is a specialization within social science, some archives have close, continued relationships with certain donors, or have continued experience with certain types of users, and consequently specialize within the field of leisure studies. One bank may become stronger in the area of the sociology of leisure, another might become more skilled in the economics of leisure; some collect data only on user patterns and visitation, still others might focus only on subsets dealing with sport.

Banks may also specialize in the scope of their data. Some are depositories of national and international studies. Others might serve a national clientele, but limit holdings to provincial or state data. Often, this is not the result of a single, conscious decision by administrators, but rather the result of responses to opportunities and requests. Whatever the cause, banks generally become more specialized over time.

In addition to bias arising from objectives and specializations of a data bank, there is bias imposed by the archivists' decisions about the quality of data and documentation. A decision not to include a particular data set is based on a number of reasons. Data may be of questionable value. Records may be missing. There may be coding errors, biased sampling, ambiguous questions, or problems with instrument design. On the other hand, qualities of a file might be adequate, at least for the original purposes of research, but documentation may be inadequate or missing, and this prevents further use of data by other researchers. A decision to archive or not archive is a technical one, made on objective grounds. However, the evaluation of whether a data set or documentation meets the objective criteria is often a subjective decision made by data bank personnel; and the quality of that decision depends upon the knowledge, skill, and ability of the specific staff.

If a data set is archived and made available for use, it is not guaranteed to be free from error or distortion. The purpose of a primary data gathering project, the wording of questions, the sampling frame and design, definitions of words and terms and how substitutions were made for non-respondents, the basis upon which a test has been standardized, interpretations or shifts in meaning by the original coder, all can cause bias in reliability and generalizability. This is why documentation is so important as a part of a data bank's holdings. As a user, you should be able to assume that the data bank staff has acquired, cleaned, stored, and retrieved data properly. You cannot make any assumption, however, about the inherent quality or characteristics of the data set without examining the associated documentation.

Access rights are another source of possible bias, not so much as a distortion in the interpretation of a particular data set as it is a distortion in the information available from a data bank. The Leisure Studies Data Bank does not accept any file that is restricted to only certain users. For example, we were given a copy of a survey of violence in a specific sport. Shortly after receiving the file we were advised that this information could not be released to all classes of potential users, and that only "approved" researchers could have access to these data. It was therefore decided to de-archive this file. The decision to include only publicly available information limits the data that can be archived, but it does ensure all potential users of availability and access. This is not always the case in other social science data banks.

The final source of possible bias is that of the donor. Here we refer not only to the types of information or questions that a collector gathers, but to the original treatment of these data. Some data are distorted before being released. In other cases data are "laundered". The process of "laundering" alters the validity and accuracy of a file. The level of aggregation of observations is another reflection of each nation's political concerns and its perceptions of privacy, social responsibility and individual rights. In North America, as in many parts of the world, it is not possible for the ordinary data user to identify specific individuals by name or address. Normally disaggregation is possible only to a subgrouping short of the individual case level. Privacy extends to protecting the identity and responses of corporations as well as individuals. Protection of identities means more than just eliminating names, addresses, case numbers, and some geocodes, it can also mean aggregating responses from small or lightly populated areas to thwart attempts to deduce the probably identity of a person or corporation. For example, if you were studying private campgrounds, and had the responses of an owner in a specific local region, state, or province that reported gross income and expenditure, you may be able to narrow identity to one or two campgrounds. To prevent this, disaggregation to a local region may be limited during the archiving process.

There is substantial variation among banks in different countries with respect to data availability. In one European nation researchers can only obtain the most generalized, averaged figures for most social statistics of their population; whereas in a neighbouring country, data files are so specific that it is possible to link individual income tax returns with responses on other social surveys to check on the validity and reliability of responses concerning income and expenditure on the social survey. Many governments retain registries of disabled persons which are available for research purposes from public agencies; this is generally not the case in North America. Some data banks regularly receive official government data for permanent archiving with the intent of providing wider access of data to researchers. Some banks have no liaison with government and have access only to academically generated data. Still others may only have access to commercially produced data. Still others may only have access to commercially produced data. Availability of social science data for research thus differs from nation to nation, and this bias influences the scope of data a researcher has for analysis.

Trends in Data Banks

One of the most important trends is the apparently contradictory tendency to become both more specific and more general. The growing specificity of a bank is the result of continued relationships with certain donors and users. A bank that develops a good working association with particular agencies, tends over time, to specialize in the information these agencies provide and need. A subtle, but important force thus slowly influences the mission of each archive. Growth of other data banks into related subjects also encourages specialization.

At the same time, there is a broadening in the perception of data files useful to researchers in a specific subject. In past years, only data files obviously related (as indicated by title of a file) to the mission of a bank would be archived. There is now a recognition that data files from unlikely sources can be of great value. For example, we have recently obtained a copy of projections used by the local public school board for educational planning. This file contains information on the number, gender, and ages of children expected in the regional population in years to come. Although this information was collected for educational planning, it is also valuable for doing feasibility studies and needs assessments for public recreation facility planning.

Another trend in data banking is toward use of more efficient and generalized technology. The newest generation of computers, and the availability of new memory technology will speed the time necessary for data processing, reduce computing costs, and increase available storage. Software packages, such as SPSS, SAS, BMD, OSIRIS, and others have been improved to match improvements in hardware and operating systems. It is now possible to work with files that would have been considered monstrous only a few years ago. The Leisure Studies Data Bank, for example, regularly assists users in working with files that contain over 1,000 variables or that have as many as 50,000 cases.

In addition to greater power and efficiency, there is a trend to greater flexibility and compatibility. Work is proceeding to develop a universal interchange file that will facilitate linking data sets or the output of one system with any of several software packages.

Just as data banks were developed to help researchers cope with data, archivists are beginning to see a need for providing assistance in helping potential users cope with the growing number of data banks. The first step is the development of a system to allow a potential user to query a bank's holdings for information about a specific topic, geographic region, or other characteristics of a data set. Because of the kind of specificity inherent in different thematic research approaches, efforts are underway to develop hierarchical modes of inquiry that may be shared among several cooperating data banks. A user at the Leisure Studies Data Bank for example, will one day be able to browse not only LSDB holdings, but leisure-related data that is part of the holdings of other universities in other countries. The significance of this system of hierarchical study descriptions or file precis is not only to allow an efficient search to be made, but to provide for common terminology and descriptions among several archives.

This growing cooperation is international in scope, and thus there is a trend in the polylingualization of archives. The international language of computers may be English, but file precis, variable labels, catalogues, and the like will need to become available in all the major languages of the world. Several data archive organizations have been established to encourage system and file exchange, cooperation and consistency among member archives. In 1965, as one example, the Council of Social Science Data Archives was established to further these goals among two dozen United States archives. Unfortunately, the differences of opinions among members was so great that the council collapsed. This is a problem and a challenge to data banks in the United States. In Canada, data archives, government, academic, and private are members of the Canadian Data Organization Committee of The Social Science Federation of Canada. A similar organization exists for Western Europe. One of the most important organizations promoting inter-archival cooperation today is the International Federation of Data Organizations, an associate member of the International Social Science Council - a UNESCO organization. Member archives are from both east and west Europe, the United States, and Canada.

Perhaps the last major trend to cite is the growing importance of data bank personnel as research consultants. Because of familiarity with different problems in research design and analysis, they acquire an overall perspective on the production and use of new data collections. Our own staff have provided consultation to a number of government and private organizations on the design of data gathering projects, on coding and weighting of data after collection, and on other related matters. Data banks also have the potential to organize groups of individual users to pursue new lines of inquiry. Because of the potential to serve as "spokespersons" for both data and computer users, these personnel can help to provide the impetus for developing computer software systems, and can become effective spokespersons for social scientists to the computer industry.

Using a Data Bank

Users of data banks fall into a number of relatively well identified groups: the unsophisticated new researcher who has not been a data user, and knows almost nothing about computers; the researcher who has had some primary research experience and some familiarity with data, but little computing experience; the experienced researcher who has considerable methodological skill, and computer literacy; the sophisticated researcher and computer user. Each of these types of users require different types of assistance from a data bank staff. The more unsophisticated a potential user is, the more likely the first few visits to a data bank will be a "fishing expedition". The more sophisticated a user is, the more specific and technical is the use of a data bank. Preliminary visits to a data bank by any user concern documentation rather than data, regardless of the level of sophistication.

In order to ensure that users have access to the archived data that will be of most use to them, documentation is usually organized on five levels.

1. File Identification -- a user may discover that a data file exists from an entry in a library catalogue, an inventory of data sets, a data bank catalogue of holdings. These citations are often cryptic, and will often include only the name of a file, and some general identifying information.

2. File Precis -- a user, upon discovering a data file that may meet research needs, then proceeds to examine more detailed information about a file. File precis are available in some library reference rooms, in data bank offices, and many are available in a hard copy form that can be mailed from a data bank to a potential user. Some banks offer machine-readable precis that can be examined on-line through an interactive computer system at a CRT terminal. A file precis describes the data, presents sampling and weighting information, indicates types of variables in the file, lists published reports based on these data, and provides a summary of the research which generated the data.

3. Source Documents -- after examining the file precis, a user may wish to consult some of the sources cited in the precis. Depending upon the practice of the bank, some data archives in collaboration with libraries have catalogued data files in the same manner as related source documents. Thus a user can examine related sources documents within a library or through inter-library loan by using the same catalogue classification codes. In many instances, a data bank will also have copies of these source documents, but these are usually for on-site use.

4. Variable Lists -- generally these are available for in-depth examination of a data file for use when designing a research plan. Hardcopy lists are usually available for each file and can be mailed to a potential user. Sometimes these lists include the source statements (from a questionaire or psycological test, etc.) which generated the variables in the data set.

5. Codebooks -- offer the user who has developed a research plan for use of a specific data set detailed information regarding the characteristics of the file structure, a complete listing of code elements specifying the variables and all values for each variable. Univariate tables in a codebook specify the frequency for each value within a variable, precise information about codes needed for processing, matrix information, CPU requirements and the like. Codebooks may be in hardcopy and sent through the mail, or may be machine readable and available on-line locally or can be used at a distance from the bank with the necessary hardware and software, and software systems documentation.

A word should be said about the nature of the files that are usually available within a bank. There are three basic types of files: raw data files, edited system files, and process produced files.

1. Raw data files are files that have been cleaned for errors, wild codes, etc. These files are stored in their cleaned "raw" form. Generally they are available to a potential user that wishes to write a special analysis programme for these data, and does not wish to use a package programme.

2. Edited system files are files that have been put through the archive process and been prepared to be used with a package analysis programme such as SPSS, SAS, OSIRIS, BMD, etc. There are often different versions of these files, such as simplified editions for new student researchers that may have some of the ordinal data grouped and labeled for simplified analysis, or the file might be reduced to a sample of cases to enhance useability when there are large numbers of records. Or a special file might have been created with an inverted matrix for use in certain factor analytic programmes by experienced researchers.

3. Process produced files are computer-generated files, based upon a researcher designed programme. Input for these files will be variables from a number of different files. The final file will be a "raw" data file, distinguished from researcher-collected data because data collection is actually internal to the computer used.

The process of using a data bank is generally the same in most locales. First a user needs to have a computer account number in order to access the required data. Access in many places today can be either through batch mode or through an interactive system. A user can either do all of his own computing or can seek assistance from data bank staff. In effect, the process is analogous to designing any research project, the only difference is that after designing the project (in this instance with the use of the data documentation) and instead of going out to collect data from households or on-site, or from some administrative reports or documents, the researcher writes a computer programme and collects the required data from the computer--data that have been stored by the data bank. Although this seems somewhat oversimplified, any working researcher knows just what all that simple formula can involve.

In many instances, there really is no need to expend the time and money to collect new data, particularly concerning leisure-related topics because there is a wealth of data available today that has never been subjected to analysis. Perhaps the biggest problem leisure researchers face today is identifying where useable data reside. Because finding these data is so difficult, the tendency for researchers is to develop research designs that include new data collection. This is not only a common practice within the field of leisure studies, but throughout the social sciences. However, as data banks become more common in universities, and are used more frequently as laboratories in the teaching of social science research, there will be a greater tendency for new researchers to think about analysis of secondary data before embarking on new data collection.

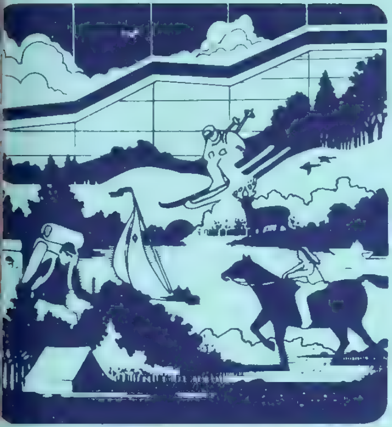
LaPage, Wilbur F., Chairman
1980. Proceedings 1980 National Outdoor Recreation Trends Symposium. Northeast. For. Exp. Stn., Broomall, Pa.
(USDA For. Serv. Gen. Tech. Rep. NE-57)

Proceedings (in two volumes) of a national symposium on recreation trends held at Durham, N.H. on April 20-23, 1980. Volume 1 contains papers on trends in selected recreation activities and in recreation planning, policy, financing, equipment, organizational membership, lands and waters. Volume 2 includes papers on industry sources of trend data, applied trend research, the use of trend data for planning, and trend measurement.

907.2

Headquarters of the Northeastern Forest Experiment Station are in Broomall, Pa. Field laboratories and research units are maintained at:

- Amherst, Massachusetts, in cooperation with the University of Massachusetts.
- Beltsville, Maryland.
- Berea, Kentucky, in cooperation with Berea College.
- Burlington, Vermont, in cooperation with the University of Vermont.
- Delaware, Ohio.
- Durham, New Hampshire, in cooperation with the University of New Hampshire.
- Hamden, Connecticut, in cooperation with Yale University.
- Kingston, Pennsylvania.
- Morgantown, West Virginia, in cooperation with West Virginia University, Morgantown.
- Orono, Maine, in cooperation with the University of Maine, Orono.
- Parsons, West Virginia.
- Princeton, West Virginia.
- Syracuse, New York, in cooperation with the State University of New York College of Environmental Sciences and Forestry at Syracuse University, Syracuse.
- University Park, Pennsylvania, in cooperation with the Pennsylvania State University.
- Warren, Pennsylvania.



PROCEEDINGS

1980 National Outdoor Recreation Trends Symposium

Volume II

U.S. Department of Agriculture, Forest Service
Northeastern Forest Experiment Station
370 Reed Road, Broomall, PA 19008

Sponsored by:

ortheast Agricultural
xperiment Stations, NE-100

SDA Forest Service

SDI Heritage Conservation
nd Recreation Service

ecreation Working Group,
ociety of American Foresters

niversity of New Hampshire,
ecreation and Parks Program

n cooperation with:

Clemson University

ournal of Leisure Research

Purdue University

CLEMSON UNIVERSITY LIBRARY
SEP 17 1980
SCI. TECH. & AGR. DIV.

USDA, Forest Service General Technical Report NE—57

FOREWORD

Volume II of these proceedings contains a wide selection of papers presented at the 1980 Outdoor Recreation Trends Symposium. It includes, in addition to papers not available for Volume I, those papers presented during the keynote session, concurrent sessions, evening sessions, and the closing session. Concurrent session papers are clustered around four topics: Trend Measurement Methodologies; Trend Data for Recreation Planning; Industry Sources of Trend Data; and Applied Trend Research.

The closing-session papers provide considerable food for thought about future directions in outdoor recreation trend research. These two papers provide a balance between the need for trend measurement for professional purposes and in the limitations of trend measurement as a means for monitoring social change.

Throughout these proceedings it has been our purpose to promote, provoke, stimulate and, we hope, encourage the establishment of new and better data systems to monitor activity effectively in all sectors of outdoor recreation. We took this approach knowing there are certain inherent risks; not having an abundance of reliable trend indicators is often a politically expedient way of conducting the public's business in outdoor recreation. During an evening session in the course of the symposium, a small group of participants chose to speculate on just what some of the risks might be if we were suddenly faced with a world where all of the necessary trend measurement systems were in place. The consensus was that a number of undesirable reactions could be readily predicted: rejection--or challenging the data because of inconsistencies and a lack of representivity; procrastination--a paralysis of programs while decision makers await the latest in a series of data; prostitution--the use of data to justify more public programs rather than use it for better planning; sanctification--the establishment and growth of specialized elite decision makers to monitor an increasing array of potentially relevant phenomena; and routinization--the complete reliance on data resulting in the disappearance of a risk-taking attitude on the part of those who are paid to make difficult decisions.

The positive aspects, we firmly believe, of better data, better planning, and better decisions easily outweigh all of these risks. But the risks are there, and as we move inevitably in the direction of greater government accountability, we need to be constantly alert to their emergence.

WILBUR F. LaPAGE, Chairman
Program Committee

THE 1980 NATIONAL

OUTDOOR RECREATION TRENDS SYMPOSIUM

Held at the New England Center for Continuing Education
University of New Hampshire
Durham, New Hampshire
April 20-23, 1980

SPONSORED BY

Northeast Agricultural Experiment Stations, Project NE-100

USDA Forest Service, Northeastern Forest Experiment Station

USDI, Heritage Conservation and Recreation Service

Society of American Foresters, Recreation Working Group

University of New Hampshire, Recreation and Parks Program

PROGRAM COMMITTEE --

- Wilbur F. LaPage
- Malcolm I. Bevins
- Robert D. Greenleaf
- Floyd L. Newby
- Gerald L. Cole
- A. Robert Koch
- Herbert E. Echelberger
- Douglas M. Knudson

CONCURRENT SESSIONS --

- Floyd L. Newby
- Herbert E. Echelberger
- Douglas M. Knudson
- Kenneth J. Hock
- Marvin W. Kottke
- Mahmood Seyala

ADVISORS --

- R. Duane Lloyd
- Earl Patric
- Basil J. F. Mott
- Roland Robinson
- Meg Maguire
- Robert McLellan
- Barry Tindall
- Hugo John
- Fred Knight

LOCAL ARRANGEMENTS --

- Robert D. Greenleaf
- Herbert E. Echelberger
- Gus C. Zaso
- Lawrence A. Rondeau
- Patricia C. Merrill

COOPERATORS

Clemson University, Department of Recreation and Park Administration

Journal of Leisure Research, NRPA

Purdue University, Department of Forestry and Natural Resources

NEW HAMPSHIRE - AN OUTDOOR RECREATION TREND LEADER[1]

George T. Hamilton[2]

It seems appropriate (at least to me) that a national symposium focusing on trends in outdoor recreation be held in the Granite State; a state which has played historically a role in the evolution of a variety of recreation activities far out of proportion to its size and population. After all, outdoor recreation is more than 150 years old here in New Hampshire. Yet should I ask you to consider the field of outdoor recreation in a national perspective, I suspect that most of you would think of a great variety of people, places, activities, agencies and organizations far removed from the State of New Hampshire. In terms of history, you might think of the states of California and New York, of the Niagara Falls Reservation and the Catskill and Adirondack Parks, of the National Park Service and Sequoia and Yellowstone, of Stephen Mather and Frederick Law Olmstead and many others. In terms of activities, you might consider boating in Florida, surfing in Hawaii, wilderness travel in Alaska, dune buggies in California, scuba diving on the Gulf Coast and hang gliding in the Rockies or mountaineering in Washington State, (or perhaps volcano watching.) With an exception or two, we have all those activities here in New Hampshire as well, along with many others.

The phrase "outdoor recreation" has not been in common usage for very long, relatively speaking. And, there has been considerable debate and speculation as to its precise definition. We never really used the term widely until the Outdoor Recreation Resources Review Commission Report brought the term forcefully to the public consciousness upon its release in 1962. In his essay "Conservation Ethic" from his book, A Sand County Almanac, Aldo Leopold discussed the complexities of defining outdoor recreation:

> "Barring love and war, few enterprises are undertaken with such abandon, or by such diverse individuals, or with so paradoxical a mixture of appetite and altruism, as that group of avocations known as outdoor recreation".

He went on to say that,

> "Recreation, however, is not the outdoors, but our reaction to it".

Well, no matter how we define it, it appears that outdoor recreation is here to stay. Here in New Hampshire we understand what Aldo Leopold is saying for we have been in this business for a long time. We have seen recreationists, or tourists, in all shapes and sizes engaging in a myriad of activities. We have fished them out of the water, located them in the deep woods, plucked them off cliffs, and carried them off the mountains. Yet tens of thousands have come year 'round for a century and a half in perfect safety in spite of themselves.

BACKGROUND - HISTORICAL NEW HAMPSHIRE

It might be helpful to take a brief look at New Hampshire's colorful history first in order to establish a background for understanding the origins and evolution of outdoor recreation in this state. Scarcely 9,300 square miles in size, it is one of the nation's smallest states, yet it is endowed with such a variety of natural beauty that it has attracted visitors from far and wide since its earliest days of existence. It enjoys a lovely, albeit limited, coastline of about 18 miles in length. The Canadian Border lies northerly about 200 miles away. One can drive across its widest point between the states of Maine and Vermont in approximately two hours. Overall lies a wealth of hills and mountains, ponds and lakes, fields and forests. As our favorite poet, Robert Frost, said in his poem "New Hampshire":

> "----Just specimens is all New Hampshire has,
> One each of everything as in a showcase
> Which naturally she doesn't care to sell----".

From sea level to the summit of Mt. Washington, our state does offer, indeed, something for almost all tastes in terms of natural attractions.

EARLY SETTLEMENT

First settled in 1623 and briefly established as an independent province, then governed by the Massachusetts Bay Colony until 1741 when it became a separate royal province once again, New Hampshire has a long and glorious history, fascinating to scholars and lay people alike. Time does not allow an in-depth review, obviously, but let us take a quick look at the evolution of the state.

---

[1] Paper presented at the National Outdoor Recreation Trends Symposium, Durham, NH, April 20-23, 1980.

[2] President, The Bank, 116 N. Main Street, Concord, NH 03301.

The first settlers found a land heavily forested. Along the coastline were huge pine trees which, along with fishing, provided the colonists with their first industry; that of cutting the huge trees and shipping them to England to be used as masts for British merchantmen and men-o'-war. These trees ranged from 150 to 200 feet in length and were from three to six feet wide at the butt end. For more than a century, New Hampshire colonists worked at this trade until the large trees were gone and the British then looked to the Province of Maine as a source of masts.

The Colonists slowly pushed inland and settled further and further from the coast. Soon after the early settlers landed, some enterprising adventurers explored the interior reaches of the area; in fact one Darby Field, accompanied by two Indian guides, followed the banks of the Saco River to the Conway intervales and ascended Mt. Washington in 1642 -- my wife, incidentally, is a direct descendent of Darby Field. But in general, the settlers were slow to proceed into the northernmost reaches of the state because of the danger from Indians during the French and Indian Wars. It wasn't until after the Revolutionary War that settlement north of the White Mountains proceeded steadily. The famous raid by Rogers Rangers against the St. Francis Indian Village in Quebec in 1759 virtually eliminated the threat of raids by the Abnakis. Sadly, the Abnakis were virtually wiped out. They were one of several tribes of the Algonquin Nation which inhabited this area. Many of their colorful names linger on since many New Hampshire locations, rivers, lakes, and mountains bear names from their language, to wit: Piscataqua, Pemigewasset, Androscoggin, Ammonoosuc, Contoocook, Coos, Winnepesaukee, Kanasatka, Waukewan, Winnesquam, Wonalancet ---.

However, during the Revolution the threat of Indian raids into northern New Hampshire became real once again, when the fierce Mohawks of the Iroquois Nation sallied into the upper reaches of the Connecticut River Valley at the behest of the British.

Following the Revolution, towns and villages were developed all the way to the Canadian Border, although it was not until the Webster-Ashburton Treaty of 1842 that New Hampshire's border with the Province of Quebec was firmly established.

OUTDOOR RECREATION, ORIGINS

Even before New Hampshire's northernmost boundary was settled, newcomers were settling in ever-increasing numbers; some from states to the south and some from other countries. As roads were constructed and railroads extended throughout the state, visitors began to appear.

Before the Revolution, circa 1769, Provincial Governor John Wentworth became enamoured with the lovely scenery around Wolfeboro and built an extensive set of buildings overlooking the shores of Lake Wentworth, thus giving the town grounds for her slogan, "Wolfeboro, Oldest Resort Town in America". In a very real sense this could be called the beginning of summer resorts and vacation travel. I suspect that after riding in a carriage from Portsmouth to Wolfeboro over a rough, dusty and very primitive roadway, one would need a vacation!

Many English and American poets and artists during the period 1825 to 1850 discovered the scenic beauties of the state, and through their works spread the word far afield. Soon visitors began to appear in large numbers. Improved roads and an extensive railroad system saw resorts sprin up all over the state. Hotels were quickly built during the 20-year period prior to the Civil War; soon after the War came the era of the Grand Hotel These imposing structures brought visitors via carriage and railroad while management served lavish meals, and catered to every whim of their guests. Along with tourists came new activities for out-of-door enjoyment; hunting, fishing, horseback riding, sightseeing, boating, hiking, and later mountaineering -- all became popular. An extensive system of summer resorts along the coastline, in the various lake regions, and around the White Mountains was clearly established. Tourism continued to grow and to flourish all through the years with only brief periods of retrenchment during times of national crisis, such as the Great Depression and World War II.

One activity in particular New Hampshire can point to as an early trend leader is hiking. Earlier we noted Darby Field's first ascent of Mt. Washington in 1642. That unusual exploit (for the times) can scarcely be singled out as the beginning of hiking as a recreational activity in New Hampshire. That distinction lies in the completion of the Crawford Path from Crawford Notch to the summit of Mt. Washington in 1820 by Ethan Allen Crawford; today that trail is distinguished as the oldest continually-used foot trail in the Nation.

In 1876 the Appalachian Mountain Club was organized in Boston and promptly focused many of its acitvities in New Hampshire where many of its members built footpaths in the White Mountains. In 1888 the Club built its first mountain hut at Madison Springs, the forerunner of the hut system, which today numbers eight units plus an extensive headquarters in Pinkham Notch which is open year 'round to the public. Through efforts of the AMC, the U.S. Forest Service, and other groups, New Hampshire has established the greatest concentration of hiking trails in the Country, a system which has been in existence since the mid 1930's. Today, hiking remains as one of the most popular outdoor recreation activities in the state with visitors coming from far and wide to enjoy this sport. Greatest concentration is on the White Mountain National Forest, as you would expect, one of the most heavily used forests in terms of recreational use nationwide.

CHRONOLOGY

Since time is limited, rather than expound at length about the chronology of various activities in detail, let me run through a list of landmark events in New Hampshire outdoor recreation with brief comments wherever appropriate:

1642 - First ascent of Mt. Washington, Darby Field

1769 - First summer resort, Governor John Wentworth built summer home in Wolfeboro

1820 - Crawford Path completed by Ethan Allen Crawford, oldest continually used trail in Nation

1853 - Construction of Tip Top House at the summit of Mt. Washington

1861 - Mt. Washington Carriage Road completed

1869 - Mt. Washington Cog Railroad completed

1888 - Madison Hut constructed at elevation 4,825', Madison-Adams Col

1901 - Society for the Protection of New Hampshire Forests organized; active through the years in contributing to public enjoyment of the outdoors

1909 - First Collegiate outing club; Dartmouth Outing Club organized

1911 - Weeks Act; permitted the creation of national forests east of the Mississippi River and White Mountain National Forest the first to be established.

1922 - Appalachian Trail efforts began; Benton MacKaye; New Hampshire trails instant part of Appalachian Trail

1931 - First ski school in United States at Pecketts-on-Sugar-Hill

1932 - First National Downhill Ski Championship held; at Mt. Moosilauke under the auspices of Dartmouth Outing Club at Ravine Lodge

- Completion of AMC Hut System; until Mizpah Hut in 1964, first and only Mountain Hut System in Nation

1933 - First National Intercollegiate Downhill Ski Championship, DOC at Mt. Moosilauke

1938 - First aerial passenger tramway in North America, Cannon Mtn., Franconia Notch State Park

- First major ski area in a state park system

1939 - First Inferno Race, Mt. Washington, won by Austrian Toni Matt in race from summit of Mt. Washington to Pinkham Notch - 4 miles - times still a record, 6 minutes, 29 seconds

1945 - Division of State Parks established as independent unit; broken away from Forestry Commission

1948 - Mt. Sunapee State Park established; second major ski area in state park system

1960 - First Private Campground Owners Association in Nation; evolved through instigation of state, co-produced Camping Guide for 20 years

1962 - First Private Campground Association to have a full-time executive director; promoted tourism; produced major camping show

1969 - Among leaders in dealing with snowmobile problems; first to lease private lands for public trails; liability insurance

MODERN ERA

This brings us to the so-called modern era which begins with the great outdoor recreation explosion of the early 1960's. (My definition). The Outdoor Recreation Resources Review Commission (ORRRC) Report had outlined for the Nation the trends and needs at local, state, and federal levels. Fortunately, many public and private organizations were already preparing for improved and expanded facilities at about the same time. Here in New Hampshire three agencies in particular were in the process of planning and constructing a variety of new facilities and services for the public; they were the U.S. Forest Service, the Division of State Parks, and the Appalachian

Mountain Club. Indeed, they have been in the forefront of trend setting in dealing with present and anticipated recreational problems.

The Forest Service instituted long range recreation planning while initiating construction of new campgrounds, picnic areas, backcountry camping facilities, and so on. The Parks System had guided a recreation bond issue throughout the Legislature in 1961 and in the ensuing years built several new parks and improved facilities in general. The AMC began an ambitious program of improvement throughout the hut system and built a new facility on the side of Mt. Clinton named the Mizpah Hut. These agencies teamed up to institute many services and policies that could truly be called trend setting in the field of outdoor recreation. To list some of them:

White Mountain National Forest

- as one of the leading "recreation" forests in the Nation, the WMNF instituted comprehensive long-range planning with public involvement which gave great credence to all aspects of outdoor recreation through unit planning
- it took steps to protect scenic areas and unique natural resources on the Forest by imposing restrictions and controls
- it undertook a variety of research projects aimed at environmental impact and user behavior
- it has done a reasonably good job in achieving balance in terms of recreation and commercial needs between the "Wilderness" and "Multiple Use" controversy

Appalachian Mountain Club

- instituted guided hikes, alpine flower walks, etc. and found great public acceptance
- started mountain leadership workshops in order to improve leadership of guided groups, especially children's groups such as scouts, YMCA, church, and other groups
- initiated "carry in, carry out" program on WMNF which contributed greatly to cleaning up trails and campsites
- demonstrated that private organization can effectively help public sector meet needs of recreationists
- devised new trail maintenance and construction techniques that became model for other sections of the Country.
- hut system continued to be model for accommodating public in mountains with pluses and minuses in terms of environmenta impact; experimented with different methods of dealing with these problems and worked closely with U.S. Forest Service and Nation Park Service

N.H. Division of State Parks

- historically park campgrounds were self-sufficient financially and charged more realistic prices than most others; first to charge differential rates; first to charge preferential rates based on site attractiveness
- demonstrated that state-operated ski areas could fulfill a need and not compete unfavorably with private areas
- held firm against intrusion of I-93 through Franconia Notch State Park; with aid of conservationists gained compromise which protected and improved park facilities and resources

To a great extent, the New Hampshire philosophy regarding the financing of park operations has been, "the user should pay", while at the same time the feeling was, and is, that capital projects which would benefit future users should be financed through general fund monies. Although this philosophy is now widely shared by other states, it has not always been so. In his book, The State Parks - Their Meaning in American Life, Freeman Tilden pointed out the following in 1962:

> "In New Hampshire - fortunately this is almost the only instance of it - successive legislatures have insisted that the state parks "pay their way". Nature provided this state with some of the most thrilling and satisfying scenery in the Country; it has never been a problem to find suitable natural areas that measure up to the most exacting criteria of the ideal state park. Yet, the insistence upon self-support has forced a director of ability and discrimination to resort to "attractions" that are obviously incompatible with the grandeur of the parks.
>
> To be fair, however, the reasons for this situation should be mentioned. New Hampshire was in the tourist business long before state parks were conceived. The same geological changes that made it, except for pockets of alluvium, a hardscrabble agricultural region endowed it with a beauty and significance that enabled it to count on income from visitors as a regular means of livelihood. Therefore, the feeling for state parks based upon cultural values - - - remained mostly in the imaginations of a few idealists".

We feel that New Hampshire has been a trend setter in terms of charging realistic rates for services rendered which would not put private operations offering similar services at a competitive disadvantage, while at the same time it has provided services which private enterprise has been either unable or unwilling to supply.

CONCLUSION

Today New Hampshire and the Nation face a most uncertain future. Many of our former guidelines, plans, policies, and services for outdoor recreation are archaic; perhaps even our philosophies as well. It is time for reevaluation; a time for sensitivity to the needs of our total constituency, a time for innovative thinking, and a time for commitment to dealing with an ever-changing society.

I feel confident that here in New Hampshire our institutions and our managers will continue to rise to the challenges of providing services and facilities in the field of outdoor recreation. We have the natural resources for it; we have a sound track record. In a sense New Hampshire has been a laboratory in this field, a microcosm of the national scene. I suspect we shall continue in some fashion to be a trend setter. The spirit of independence which we have inherited here has stood us in good stead. New Hampshire people have demonstrated resourcefulness and leadership when the need has arisen. As Robert Frost said:

> "When I left Massachusetts years ago between two days, the reason why I sought New Hampshire, not Connecticut, Rhode Island, New York, or Vermont was this: Where I was living then, New Hampshire offered the nearest boundary to escape across. I hadn't an illusion in my hand-bag about the people being better there than those I left behind. I thought they weren't. I thought they couldn't be. And yet they were ---".

RECREATION TRENDS: INDICATORS OF ENVIRONMENTAL QUALITY[1]

Roy Feuchter[2]

As you probably know, tomorrow is Earth Day-80, the 10th anniversary of the original Earth Day, so it is certainly appropriate that we talk these next few days about environmental quality and the relationship of outdoor recreation to that quality. However, perhaps the title should be more of a question such as: Are recreation trends indicators of environmental quality? Or do recreation trends follow environmental quality trends?

Maybe they should, but I think it is probably not so! For example, we have had many new environmental laws in the last decade, and much significant progress towards environmental improvement. But recreation trends haven't included a commensurate recognition of the importance of recreation, nor of an enhancement of the quality of the experience! In fact, the trends in outdoor recreation have been towards a reduction of the environmental quality! Overcrowding, reduced services, limited expansion of facilities and programs have all been leading to degradation of the social environment or quality of the recreation experience.

Further, recreation management has not been keeping up with the level of management we had attained 20 years ago! Our use is increasing rapidly, but I'm afraid that our management expertise is not! In addition, our clientele is changing and our response has been to react in terms of old norms rather than provide leadership to dampen or reverse the change. As a consequence, quality of experience is slipping.

In the past, we simply provided more opportunities and the quality of the experience went up because our users were either experienced or had backgrounds that allowed them to participate easily and fully. In the future as we continue to urbanize, we will probably have to teach people what is available, where it is, how to reach it, and how to participate--in addition to providing quality opportunities. And providing the opportunities will also be more difficult since there will be more people, more conflicts, more impacts, and probably relatively less resources to work with.

This leads me to conclude that we must do more in the future than we have in the past to influence the direction of future recreation trends. We need to establish some trends for management (Management trends) to insure that the pattern of future recreation trends will clearly indicate increased environmental quality rather than decrease it. As you move through this symposium, I hope you will keep that possibility in mind; and to help you with that, I will suggest some management trends that I feel are needed. Some of them are responses to trends you will be discussing here at the symposium. Others are efforts to influence our future trends.

Probably we all subscribe to the philosophy of improving the quality of the recreation experience. We subscribe, but we have had trouble producing the quality. What is needed are some better ways to manage for that quality. Coupling that with the obvious changes in clientele, or potential clientele, that can be foreseen, and the need to strengthen management, leads me to believe that the field of interpretation needs to be one of our management trends. It can help to improve the quality of the experience by helping users participate and by helping solve management problems, and by providing user-feedback systems which develop real ways of talking to users and measuring satisfaction and involving the public in our actions in educational ways. I would include here development of measures of how well we are meeting our goals, and also measures to identify factors that influence user participation.

Much of this kind of information could be of great value to the private sector as well as public suppliers of recreation, and this leads to another management trend. We must somehow involve the private sector more in the supply of natural resource-based outdoor recreation. Most public recreation administrators have offered this goal for years, but it appears to me that the trend doesn't predict fulfillment of that goal. For the most part, we are probably no further ahead than we were 20 years ago. Consequently we need to:

(a) Reduce public sector competition with the private suppliers of outdoor recreation opportunities. We in the public sector have been slow to fully consider the possibilities of pricing, location, and substitutability in relation to reducing competition.

---

[1] Paper presented at the National Outdoor Recreation Trends Symposium, Durham, NH, April 20-23, 1980.

[2] Director, Recreation Management, USDA Forest Service, Washington, D.C. 20250.

(b) Encourage more complete recreation packages for private sector operations while keeping in mind our goals for high quality experiences in natural resource-based outdoor recreation. An example here would be more summer use of winter sports sites, complete with interpretive programs.

(c) Help make private land more accessible. Basically, of course, it must be profitable or otherwise beneficial to the landowner. Consequently, we need more attention to tax incentives, to reduce liability, and again, to reduce competition from the public sector. We might also consider enabling legislation to provide more flexibility for public sector use of private professionals in design, inspection, and consulting.

We also need to develop a management trend towards more professionalism in our recreation managers. They need to make better use of what's gone before, and have a better knowledge of the techniques and aids that exist for management. They will also be learning more of what is happening in the profession and with users--and they will need to know more about why and how to influence it. And they will need to learn how to develop more economic analyses to determine cost-effectiveness--of dispersed recreation, for example.

Monitoring must be a management trend. It's a legal requirement now under many of the environmental laws. It's also going to be a necessity if we are to know whether we are, in fact, really providing those quality experiences. We will need to monitor user satisfaction and participation and demands, of course, but also we need to monitor professional performance, and we must learn to monitor or determine need as well as demand. Our ability to identify and monitor that difference will be a measure of our expertise as recreation professionals! We must, to some extent, be willing to make determinations of need and then influence trends by designing to meet those needs.

But probably the biggest management trend of all is the need to quantify the social (non-economic) values of natural resource-based outdoor recreation--or at least develop ways to demonstrate that value. I believe there is, in fact, a relationship between the quality of our outdoor recreation and environmental quality or the quality of life in America. But we need measures of that quality and that relationship, and measures of the value of that recreation. We must develop output measures that can be converted to targets so that we can demonstrate recreation's relative importance with the other renewable resources--and to allow us to manage for quality.

Now you may feel there are already adequate measures of value. Certainly the "willingness-to-pay" concept is one good way to develop value of recreation, but it can measure only that element of need that the user recognizes. That is, if we recognize the relationship of natural resource-based outdoor recreation to some of our social nee then our willingness to pay for that recreation ca establish a value. But often, in fact probably in the majority of cases, recreationists do not fully recognize such relationships. Consequently we recreation professionals must take the lead in identifying those relationships and in demonstrati the true value and importance of outdoor recreatio to the American people.

We must identify that outdoor recreation can provide social values, and demonstrate that it offers alternatives to the pressures of urbanizati specialization, and modernization. During this symposium, you will be looking at trends in urbaniza tion and the pressures they generate, and I imagine you'll be discussing possible changes that may take place in cities to reduce those pressures and to reduce the need to leave the cities temporarily to escape the pressures. And certainly fuel constrai may also influence the ability to go very far in search of natural resource-based outdoor recreation. But I expect that the need for such recreation--and in remote areas--will continue high during most of our careers.

So this brings me to my final management tren

We have to think in terms of energy-efficient recreation and establish a management trend whereby we can help to make the more remote, rural, natural resource-based outdoor recreation opportunities more accessible to urban populations.

We will need:

- new and creative transportation planning,
- utilization and creation of new public transportation,
- coordinated vacation packages that involve many levels of suppliers, many of whom have historically not worked together, and
- innovative ways to make existing equipment or facilities more usable.

When we couple this with the interpretive efforts I spoke of earlier, we can make quality outdoor recreation opportunities available to urban residents including the special populations.

So in closing, I would encourage all of you to play a more active role in determining the future recreation trends so that they may indeed become indicators of environmental quality.

CONVERGING SOCIAL TRENDS--EMERGING OUTDOOR RECREATION ISSUES[1]

Carl H. Reidel[2]

I can't recall when I have attended a national conference with a more clearly defined objective than this one. We are here to document outdoor recreation trends and explore their meaning for the future. The word "trend" appears no less than 45 times in the conference brochure, and the symposium organizers are determined that the proceedings will be "the most comprehensive assessment of outdoor recreation trends ever compiled."

It is a timely objective. Competition for scarce public appropriations and limited private capital will require solid evidence if new programs are to be funded. As professionals we must be constantly attuned to changing trends and able to interpret their implications for the future--especially those of us concerned with the management of natural resources. A forester colleague of mine put it this way: (He was talking about professional foresters, but I believe it applies to all of us here.)

> Since our ultimate professional interest . . . is in management of our resources, our ultimate interest is in the shape of the future. For management is decision making, and decisions cannot be made about the past--or about the present, either. Only the future is subject to decision. The context of management lies in the future. (William A. Duerr)

Yet, knowing the truth of that statement, we know also that the future is increasingly difficult to foresee. Perhaps this is because of the speed with which we are approaching the future--a sort of professional "future shock." Perhaps it is because of our preoccupation with present crises and growing uncertainty about the likely outcomes--a loss of faith in the lessons of past experience. One might well define the current economic inflation as the price of hopelessness; the cost of uncertainty; the economic expression of our unwillingness to plan for a tomorrow that we cannot comprehend.

But, whatever the reasons, we are finding future-telling an increasingly difficult task. Even with vastly improved methods of electronic data analysis and sophisticated planning techniques unknown a decade ago, we are aware that something is lacking in our understanding of the world in which we live, especially in the realm of social phenomenon. I am not alone in this feeling of doubt about our skills in interpreting the future implication of social information.

In the Social Science Research Council's recent annual report, the Council's president, Kenneth Prewitt, admits that social scientists are feeling "a serious and widespread uneasiness" over their inability to provide "intelligible and plausible" explanations for a number of important social phenomena." He lists "stagflation, Johnny's inability to read, artistic creativity, the rise of new religious movements, the causes and conditions of happiness, and radically different rates of economic development," among others. He points out that, while social scientists have adopted quantitative methods in most of their research, rigorous measurement and modeling hasn't provided the depth of understanding expected. As a result, he sees the social sciences "groping toward the humanities" in an effort to find better explanations and new perspectives.

Though not terribly comforting, I think Mr. Prewitt has discovered what most of you have learned from experience as practicing professionals: that no matter how much data you have, or how sophisticated your analytical skills, good decisions cannot simply be computed. It takes something more. Good management is an art, as well as science. And the "art" is a blend of creativity and intuition--the insight to read trends without making them self-fulfilling prophecies; to understand that trend need not be destiny.

I am convinced that this understanding of decision making--and, thus, future telling--is especially important today. Change is coming too fast. Synergy and complexity are generating previously unknown social phenomena. Yesterday's data and last year's trends may, or may not,

---

[1] Paper presented at the National Outdoor Recreation Trends Symposium, Durham, NH, April 20-23, 1980.

[2] Director of the Environmental Program, and Daniel Clarke Sanders Professor of Environmental Studies, Professor of Forest Policy, University of Vermont. JOHN D. MEYERS, junior student in Environmental Studies, University of Vermont, contributed substantially to the ideas expressed in this address.

explain today's situation or tomorrow's prospects.

In saying this, you may wonder what I am doing here attempting to explain the meaning of social trends and emerging issues; to talk about a future for which I am suggesting that there may be very little reliable information on which to base forecasts. I should have had the good sense to heed Mark Twain's sage advice that it is "better to remain silent and appear stupid, than to open your mouth and remove all doubt." But, on the other hand, why not? Only time can prove me right or wrong.

All this may seem like a lengthy build-up to suggesting that I can't really address the advertised topic. It isn't! Rather, I want to encourage you to do what I will be trying to do in the next few minutes: to participate in this symposium using imagination as much as reason; to depend on intuition as much as analysis; and to trust your insight as well as your data. This is not to suggest that we should be less rigorous in our analyses of the trend information to be presented, or that we abandon our quantitative tools. What I am saying is that even more than our data processing skills, we must depend on our creative abilities as we seek to understand the future.

Enough preamble. Let me attempt some future telling, relying on both facts and fancy. These are ideas you've probably heard before. You may not agree. But I'm not seeking your agreement as much as I am your willingness to speculate with me--your willingness to explore some alternative futures.

A Future of Change

If there is one clear trend today, it is that change is a permanent characteristic of modern life. We are learning the meaning of exponential rates of change in all realms of society. The pace is quickening, and our sense of uncertainty about the future is growing.

We see growing alienation of individuals to systems of centralized decision making, and a steady weakening of traditional social values as our institutions lag in their ability to adapt to technological change. We are frustrated that even our rapidly expanding knowledge of the world in which we live only seems to create more uncertainty. Every new solution suggests even greater problems; today's breakthrough is tomorrow's crisis. In a few decades, the promises of DDT and nuclear power, of saccharin and interstate highways, of PCB's and urban renewal have somehow soured.

Future shock is as common as the common cold, and we have no reason to expect the rates of change in our society to slow down in the near future. The best we can do is to be flexible; to avoid building institutions and programs than cannot adapt to change.

But let me be more specific by focusing on a few changes that have special significance for outdoor recreation.

The Energy "Crisis"

No change has come upon us with such unexpected force than has the energy crisis. I will not burden you with the statistics that hav become all too familiar in the past few years. Nor am I willing to debate the authenticity of this crisis, except to suggest that "crisis" is inappropriate word to describe the present energ situation. The idea of a crisis infers the problem is severe, but passing. Nothing could b farther from reality. The "crisis" is already past. The situation is permanent. We will be living with reduced supplies and increasing prices for decades to come.

I doubt that I need to interpret the meanin of the energy situation for outdoor recreation. Pleasure driving and long-distance auto vacation will soon become genuine American Graffiti. I doubt, however, that Americans will simply stay home, jogging around the subdivision or playing tennis at the high school. But we'll surely shorten the range of our recreation trips. Recreation vehicles, energy-hungry boats and ORV may not disappear, but it's clear they will not be the playthings of the average American.

With energy conservation the only realistic way to quickly reduce our reliance on imported o we must look forward to some profound changes in the way we live; certainly in the way we play. Whatever you may imagine about the future of outdoor recreation, it had better include some care thinking about energy--thinking that cannot rely heavily on any past trends.

Changing Life Styles

But even if the energy situation hadn't changed so radically, I think we could still anticipate major revisions in the character of outdoor recreation in the United States. Our life styles are being reshaped by significant changes in demographic patterns and social values.

With the war babies moving into their thirties, our median age is rising toward a projected 35 years in 2000. With later marriage lower birth rates, more frequent divorce, and rising social acceptance of unmarried women, single Americans will share power with the family in shaping recreation patterns. Coupled with increasing urbanization and restrained auto travel, pressures for expanded recreation opportunities in our major metropolitan areas will be immense. People will have more time off as work weeks shorten and, if current trends continue, they will spend an increasing share of their incomes on leisure time activities; pushing demands on facilities even higher.

It's not my task to define the recreation pursuits this older, urban, often single American will seek, but the present trend toward active physical recreation seems likely to continue. Concern with personal physical health is evident everywhere: herds of joggers along the Potomac, nutrition charts and diet books at supermarket checkout counters, and relentless TV ads about active living as the road to happiness, sex, and self-fulfillment. It's difficult to sort out whether this new preoccupation with one's body is a reaction to our increasingly unhealthy environment, simply a new form of national vanity created by media hype that looking healthy is half the fun of disco, or something deeper.

Regardless of the reason, I think it's here to stay. And I think it's a deeper social change than we suspect--a change reflecting our new awareness of environmental quality, better health education, and some important shifts in our attitudes toward ourselves and our work.

The Emerging American Women

With increasing numbers of women entering the work force, and with barriers to their assuming roles previously reserved to men gradually eroding, we should see a shift in female recreation interests. Like men, interest in challenging and high risk sports will grow as women seek the psychological relief of such recreation from work pressures. Whether singles or family members, women will also have an increasing influence in deciding on group and family recreation patterns. Old patterns of weekend recreation, backyard sports, and summer vacations dictated by Dad and the kids will give way to shared decisions. In families where the woman's income represents a substantial increase in discretionary income, she will further influence changes in recreation patterns by providing economic resources for new activities.

On the negative side, the emerging role of American women as equal partners with men in work and play could mean a substantial decline in the numbers of volunteers working with recreation organizations. Women have played a significant role in many youth organizations and, unless men now begin to share these volunteer tasks, we can expect decreasing recreation opportunities for youth through these traditional groups.

Changing Work Ethics

Changes in national attitudes toward work and play will not be confined to women, however. Something is happening to our view of work in an even more profound way. We seem to be losing much of our earlier faith in the American Dream--that hard work will get you ahead; that one's work is the highest expression of freedom and choice in a democracy. Perhaps it is the heavy hand of inflation, coupled with the uncertainties of energy shortages and international tensions. Whatever the genesis, there is a growing sense that our freedom of opportunity--the chance to win a larger slice of the economic pie--is being constrained. If this is true, it has important implications for outdoor recreation.

While recreation was once considered a luxury or, at best, an earned respite from work, it is increasingly becoming an imperative. As opportunities for creative innovation at work are limited by economic constraints, and worker mobility is reduced by mortgage interest rates and transportation costs, recreation will become one of the few remaining realms of life where one can make personal choices. As recreation is recognized as the last chance to exert personal freedom, leisure will increasingly be valued as a civil right. And, as work options are limited, people will begin to define personal success in terms of their leisure accomplishments almost as commonly as we now do our career achievements. When that happens outdoor recreation will become a far more important political issue than ever before. With the possible exception of Robert Moses in New York, few political leaders have used public recreation as an effective political weapon. That may well be changing.

Economic Restraints

This change in the political stature of outdoor recreation could be further accentuated by current economic trends. As Proposition 13 thinking moves from the state house to Capitol Hill, we can clearly anticipate reductions in federal and state spending on outdoor recreation. And this could become a long-term trend as defense and energy mobilization programs command major new budget commitments for years to come. At the very time when rising consumer spending on recreation is expected, this proportional reduction in public spending will intensify user conflicts over facilities. As special interests compete for scarce public dollars and overused recreation sites, political tensions will escalate. For the outdoor recreation industry, however, this may be the golden opportunity for investment in heretofore publicly-supported facilities, with little fear of competition from free government areas.

Converging Trends?

These, then, are some of the broad social trends which will influence the future of outdoor recreation. But what do they add up to, in terms of specific recreation issues that those of us here must grapple with in the future? The answer to that question will, hopefully, emerge in part during this symposium. And rather than a single set of answers, I expect we will find that there are several possible scenarios, depending on the kind of future we want and seek as a society.

Let me suggest but one such scenario, in an attempt to address the specific topic assigned to me in the title of this address -- "converging social trends." If the trends I've touched upon in terms of energy, life style changes, and revised work ethics do converge, what is the probable outcome in human and social terms?

The country I envision will be one characterized by individualism, by special-interest group power, and by political and social regionalism. In sum, a nation considerably more decentralized than we have known for decades. Let me take these three characteristics one at a time.

First, we can expect people to place great importance on individualism; on unrestrained freedom of personal thought and action. This idea has been developed in some depth by Alvin Toffler in his new book *The Third Wave*. He foresees a new "de-massified society" where the computer will smash the mass culture of today; where the mass media will lose control as individuals at video terminals will select information and computerized, one-at-a-time custom manufacturing will make it possible to tailor-make almost anything.

While I am uncomfortable with Toffler's high-technology scenario, I am persuaded that the kind of individualism he suggests is on the rise. As the civil rights movements of the past few decades reshape our cultural attitudes, the acceptance of personal diversity will pervade society. People everywhere are rapidly becoming more accepting of others' values and life styles and they are seeking their own distinctive identities through clothing, home furnishings, career changes, alternative family styles, and, increasingly, through their recreation pursuits. Not only are they seeking unique and diverse forms of recreation in order to escape the anonymity of mass culture, but they are aspiring to new levels of achievement previously reserved for amateur fanatics and professional athletes.

What this means for the recreation industry is not completely clear. Perhaps it will mean less faddishness, with fewer major shifts in national recreation interests. Perhaps it will mean public support for a much wider range of recreation activities and deeper commitments to excellence, with growing demands for better quality facilities and equipment than in the past. But whatever these trends mean for the recreation industry, or in terms of consumer behavior, I am convinced that they will have important political implications.

The Second aspect of the decentralized society will be a strengthening of special interest group power. In a way this seems to be a contradiction of the growing acceptance of personal individualism I've just described. But rather than reflecting personal prejudice and interpersonal conflict, however, the rapid growth of special interest groups reflects a reaction to centralized authority; to the power of big government and big business. The result may well be a struggle between interest groups as they compete for public monies, facilities, or land use control, but the real impacts will be felt in Washington, not among the minorities who lose a particular battle.

In the long run, the impact of this special interest infighting will be that timely and critical political decisions will be increasingly difficult to make at the national level. Coupled with the steady weakening of broad-based political parties, special interest power will make it impossible to build majority constituencies for enlightened national policies. We already see th Congress unable to develop comprehensive policies for energy, for the reorganization of natural resource agencies, or for a systematic classification of remaining roadless areas on public lands. And as Congress and the executive branch are further paralyzed by conflicting special interest group pressures, we can expect the alrea enormous backlog of litigation clogging the court to increase. A recent example is the district court decision in California throwing out the Forest Service's environmental impact statement for RARE II, a ruling that could effectively nullify the entire RARE II program and send the problem of wilderness classification back to the Congress. If that happens, we will see the biggest special interest alley fight over natural resources in history.

The list of potential user conflicts is almost endless. Wherever a strong special intere group seeks special consideration, and resources are limited, conflict will be inevitable. Win-lose fights in the courts and legislatures will be common. Whether wilderness advocates against snowmobilers, the contests will be heated. Urban based conflicts will be even more common as limited open space and parklands are sought by team and court sport groups for expanded facilities. Wetlands will be another arena for conflict as preservationists battle recreation groups for limited shore and water resources, especially for previously polluted waters now clean enough for recreation development or wild area reservation.

These conflicts will further fragment the already shaky coalition of conservation and environmental interests in the Nation, weakening the ability of national organizations to mediate conflict and guide compromise bills through

Congress. The trend toward decentralization will be inexorable once it gets moving.

On the positive side, however, the growing power of special interest groups can be viewed as the product of people's willingness to become involved; a reflection of their willingness to make a commitment to a cause with a group of likeminded enthusiasts. And, while the early impacts of this new era of special interest power may seem destructive of traditional American regionalism with its corresponding high level of local political involvement.

A New Regionalism

I'm obviously getting on thin ice to suggest that all the fact and fancy I've employed so far leads to such a single-minded convergence of forces, but the logic of such a scenario is compelling. Energy costs will certainly be a powerful force in reducing interregional transfers of resources, people, and commodities. Life styles appropriate to the southwestern United States, for example, will no longer be transferable to New England simply by an advertising blitz or corporate franchising. Nor will it be possible for the federal government to ignore regional energy limitations. New policies will have to be built on a sound understanding of unique regional needs, and designed to strengthen state and local institutions essential for policy implementation. Special interest groups will block federal initiatives unresponsive to their local constituents, making recognition of regional distinctives a national imperative.

I am convinced, therefore, that the future of natural resource management -- and the management of outdoor recreation resources -- will be decided at local, state, and regional levels. It has to be. That is where ecosystems, land use patterns, and cultural values come into focus in sufficient detail to make meaningful decisions possible. That is the level where special interest groups might be able to find common ground in terms of people's values and the economic realities of day-to-day living.

I personally find such a trend toward regionalism exciting. We might, as a people, be forced again to discover that special "sense of place" which defines our relationship to one another and the land where we live. This rediscovery of our "sense of place" -- this new regionalism -- need not be a return to local isolationism or parochialism. For, as Rene Dubos has suggested, we must "think globally and act locally." We must be fully aware of the national and global context in which we live. We must take full advantage of modern communications and electronic information processing to understand the limits and opportunities of our special place. But, when it comes to making decisions about how to respond to outside forces and local capabilities, we will take action on a regional basis and ultimately at a very local level. It's a sort of "small is beautiful" philosophy tempered by a realistic awareness of global forces. It's a practical expression of our "sense of place" in action terms.

Lest you think I am painting a picture of a new Brigadoon, regionalism will have its own set of special problems and issues of significance for outdoor recreation. Struggles over basic questions of property rights will intensify as user groups contend for access to water and land resources. As new owners of increasingly smaller parcels of land in many regions post their lands against public use we will see new initiatives to limit property rights, especially as land values soar and public acquisition budgets are reduced. Contests between various user groups with specialized facilities needs will likewise intensify as federal revenue sharing programs are eliminated and local governments withdraw from recreation program management.

But because of decentralized modes of personal and political decision making, patterns of outdoor recreation will vary across the Nation. Distinctive regional identities will re-emerge with their own unique playtime and sport preferences. In addition, energy limitations and other emerging regional cultural values will influence outdoor recreation interests, merging into identifiable styles of living that will exert a powerful influence on where people seek to live and work.

The head of Vermont's Agency of Environmental Conservation, Brendan Whittaker, once speculated about such trends something like this: Places like Vermont, where energy limitations will be severe and where environmental awareness is high, will attract a certain kind of person. Other areas, where energy is relatively cheap and people value old-fashioned consumer patterns, will attract different types of people. Thus, he speculated, Vermont may be relatively poor in growth-economics terms, colder, cleaner, and populated by rugged individualists who value their environmental amenities and are willing to cut firewood. Other areas, perhaps in the southwest, will be warmer, richer, and dirtier, populated by people who prefer large cars, air conditioning, and electric heat, and who are too busy "to smell the roses."

In either place, those of us concerned about outdoor recreation will have our jobs cut out for us. We will have to be prepared to respond to local and regional differences; to adapt national policies and programs to regional patterns; and to reinterpret the meaning of past trends from yesterday's mass society. It will be hard, but fun. Our clients will be less fickle and unpredictable. They will be seeking higher quality experiences and more durable, well-designed facilities and equipment. They will be well informed about their sport or activity, and prepared to support agencies or companies with whom they agree through effective special interest political organizations.

Whether or not you agree with this brief scenario for tomorrow; whether you like it or not, I hope I have provoked you to think about some better alternatives. If this symposium is to be more than a recitation of data about trends, and more than an exercise in projecting the past on a straight line into the future, you will have to employ your creative abilities to the limit. The future is not waiting out there to be discovered. It doesn't yet exist. It will be no better than we can imagine; no better than we are determined to make it. Trends may enlighten our understanding of the alternatives, but they will be destiny only if we insist.

TRENDS IN OUTDOOR RECREATION LEGISLATION[1]

George H. Siehl[2]

The two decades which have passed since the era of the Outdoor Recreation Resources Review Commission (ORRRC) have been active and fruitful in terms of Federal recreation legislation. The Commission and its final report "Outdoor Recreation for America" strongly influenced the burst of recreation legislation in the 1960's. Even today, the studies prepared under the guidance of the Commission continue to provide useful baseline data. This paper addresses three areas of trends in outdoor recreation legislation--trends in context, content, and consequences.

TRENDS IN CONTEXT

This is the simplest of the trend areas. It is based upon the realization that recreation is not one of those fields--such as national defense or education--that is considered as an entity by the Congress. Rather it is treated as one member of a family of issues. In the case of recreation, it entered the decade of the 60's as part of the bundle of issues called conservation, a context which consisted in large part of a philosophy toward the uses of natural resources. That philosophy embraced the concept of "balance" between consumption and protection of resources.

For a time after the completion of the ORRRC, the level of legislative activity was high enough to make it seem as if recreation might be important enough to stand alone.

During the mid to late 60's, however, the idea of conservation was being transformed into the broader concept of environmentalism. One catalyst to this transformation, I believe, was the "natural beauty" campaign of Mrs. Lyndon B. Johnson. Her efforts (and the support of President Johnson didn't hurt) brought a wide degree of public awareness that amenities such as parks and recreation areas are important components in determining the quality of life. Further, the public came to recognize the interrelatedness of various activities and the tradeoffs which take place among economics, environment and, a little later, energy.

Thus, through the late 60's and midway into the 70's, recreation considerations were tied to the concept of the environment. Environmentalism differs from conservation rather significantly, however. The environmental movement in seeking to check pollution and other types of degradation has adopted a highly protective stance. For recreation matters, this frequently results in support of preservation efforts and seldom in support of more intensive or development-oriented forms of recreation.

The preservation movement has secured legislation protecting areas which future generations may enjoy. A high price may be paid for these successes, if, as seems to be likely, the broader recreation community has been divided into new preservation and old conservation camps, each of which goes its own way or enters into new contextual relationships.

Where could the user recreationists--as opposed to the preserver recreationists--find their new context? The answer seems to be the economy. The formation of a 243 member Recreation and Tourism Caucus in the House of Representatives; the concerted action of the Congress to prevent weekend gas station closings as part of the President's proposed standby energy conservation program; and the strong reaction to the Energy Department's proposed regulation which could prohibit weekend operation of powerboats in times of energy shortage seems to indicate that Congressional support is there for use-oriented recreationists. The reason is that recreation and tourism are of widespread, major economic importance. As the state of the economy worsens, Congress will possibly become even more protective of viable recreation enterprises.

At the same time, preservation efforts may not be as successful as in recent years, particularly when the choice is to create a new

---

[1] Paper presented at the National Outdoor Recreation Trends Symposium, Durham, NH, April 20-23, 1980.

[2] Analyst in Environmental Policy, Library of Congress, Washington, D.C. 20540.

Wilderness area or allow the recovery of an energy resource or a strategic mineral resource. The context for preservation decisions could shift from environmental protection to the completely different arena of national security. Perhaps with the MX missle siting proposal and the controversy over the cobalt deposits in the proposed West Panther Creek wilderness area, the shift is already underway.

TRENDS IN CONTENT

In the past 20 years there have been hundreds of recreation laws passed, thousands of bills introduced, and billions of dollars authorized and appropriated. What were the details of all that legislation?

Instead of reviewing all that's happened, let's look at the trends in five content categories--although that does not exhaust all the possibilities. The five are:

1. Authorization of Federal park and recreation areas;
2. Authorization, planning and management of Federal resource agencies;
3. Assistance to non-Federal agencies;
4. Financing Federal recreation areas; and
5. Related environmental legislation.

In the first category--authorization of Federal park and recreation areas--there are several noticeable trends. Foremost is the trend which saw the number of units increase sharply. The National Park Service, for instance, numbered 209 units in 1960, 281 in 1970, and today 320; including the Executive withdrawals in Alaska. Acreage figures have increased correspondingly. A second, closely-related trend is that toward the acquisition of private lands for addition to the public recreation estate. The authorization of Cape Cod National Seashore in 1961 marked the first time that Congress went to the Federal treasury to buy all the lands for a Federal recreation unit. Earlier Eastern additions to the Park System, such as Shenandoah National Park, Virginia, and Acadia National Park, Maine, were acquired through private, state, and local funding efforts, then donated to the Federal government. Buying land for parks was much more expensive than setting the acreage aside from other Federal holdings; hence a third trend in recreation legislation, acceptance of increased costs.

A fourth trend in the authorizations of new Federal recreation areas has been the creation of specialized areas as wilderness, wild and scenic rivers, and national trails. The establishment of national seashores and national lakeshores is further indication of the trend toward recognizing the attractiveness of certain natural features to outdoor recreationists. The creation of designated National Recreation Areas to be managed for intensive recreational use shows Congress has been aware of a broad public demand for recreation opportunities.

The second trend category, dealing with the structure and administration of those Federal agencies with recreational responsibilities, would include as its highlight the 1963 Congressional authorization which led to the establishment of the Bureau of Outdoor Recreation (BOR) in the Department of the Interior. Other pertinent legislation includes the 1960 Multiple-Use Sustained Yield Act, the Resources Planning Act of 1974, and its 1976 amendment, these relating to forested lands and especially the Forest Service, and the more recent organic act for the Bureau of Land Management, the Federal Land Policy and Management Act of 1976. These enactments were not principally directed toward recreation, but they do help to ensure that recreation is one of the purposes for which Federal lands will be managed.

Assistance to non-Federal recreation agencies, the third trend category, is headed by enactment of the Land and Water Conservation Fund. This mechanism has provided over 2.5 billion dollars to the States since 1965 to assist in the planning, acquisition and development of outdoor recreation facilities. Federal recreation legislation has also provided for the donation of surplus Federal real property to other units of government for recreational use. Further, Federal agencies may give technical assistance in recreational matters to non-Federal resource agencies. This was one of the provisions of the 1963 Act which led to creation of the BOR. The level of funding support to the States has increased over the years since 1965, clear evidence the Congress has seen the need for a partnership approach to meeting outdoor recreation needs. Although there have been occasional disruptions in this support program (the most serious of which is now threatened in the President's revised budget request), the trendline has been clearly upward.

Much of what was said about the assistance provided to State and local government applies to the fourth trend category--financing Federal recreation areas and activities. The Land and Water Conservation Fund has been helpful in securing the passage of authorizing legislation for new recreation areas because Members did not have to vote at the same time to appropriate more money. The funding for the unit would come from the LWCF. The need to vote to put more money into the Fund was largely done away with by tapping the mineral leasing revenues from the Outer Continental Shelf in the 1968 amendments to the LWCF Act. It was through this mechanism that the Fund grew from $120 million in 1966 to its current authorized evel of $1 billion.

The authorized funding level provides light solace to recreationists at this time. resident Carter requested less than full unding ($580 million) in his first budget equest for FY 81. The Congress reduced that igure in Committee action to $290 million. hen the revised Carter budget lowered the equest to $233 million. Some are reminded of he pre-LWCF days when some Members would vote or establishment of a park unit and later ote against the appropriation of funds for cquisition.

To summarize the trend in financing, one ight say that it is up, but not certain.

The final category of legislative trend s that of environmental laws which provide irect or indirect support to outdoor recreaion. Clean water bills have resulted in housand of miles of cleaner streams and ivers and thus restored an important recreaion resource. Thus, water bodies once again ay support recreation fishing and boating and ater contact sports. Further progress in this egard is to be expected. The 1977 amendments o the Clean Air Act stipulate that certain ark and wilderness areas are to be protected rom significant deterioration of their air uality.

TRENDS IN CONSEQUENCES

Passing a law is something like passing message because after transmission, the outome sometimes varies from the intent. These nadvertencies of legislative action may prouce trends with broad, but delayed consequences.

One such trend is bringing the Park Serice back to town. During the decade of the 970's Congress enacted legislation to establish izeable units of the National Park Service in ew York (Gateway National Recreation Area), an Francisco (Golden Gate National Recreation rea), Cleveland-Akron (Cuyohoga Valley National ecreation Area), Atlanta (Chattahoochee River ational Recreation Area), Lowell (Lowell ational Historical Park), and Los Angeles Santa Monica Mountains National Recreation rea). Many applaud this movement of parks to he people. However, these urban areas tend o be expensive to acquire and to operate ecause they are rather manpower intensive.

In an era of unlimited Federal resources program of helping to meet urban recreation nd open space needs when local government annot do so may help to achieve a balance in ecreational opportunities. When the Federal esources become limited, as now, what will be he consequences? If the available financial nd manpower resources are concentrated on the xpensive urban areas, what happens to the traditional Park System units? We may be about to find out.

Another trend in consequences, which was touched upon in the discussion of trends in context, is that in legislation for recreation preservation the opportunities for recreation provision are being reduced. This is perhaps best exemplified at the largest scale by noting that the creation of new wilderness areas has eliminated some possibilities for developing new alpine skiing areas. A mechanism which emphasizes one recreational use without providing for similar consideration of others inadvertently reduces the likelihood of examining alternative uses. Enactment of something like a Developed Recreational Facilities Siting Act might balance the effectiveness of the Wilderness Act and so provide even greater recreational opportunities.

UNTOUCHED TRENDS IN RECREATION LEGISLATION

The coverage of this paper has omitted more legislation than it has included. It has, however, identified some of the more important trends which might be discovered in a lengthier review. There are other trends which might be examined in some future forum. Two which come immediately to mind are the changes which have taken place in the Congress and in the outdoor recreation constituencies.

In the first instance, we should note that the guard has changed, and that many of the prime shapers of Federal recreation legislation and systems are gone from the Washington scene. Their experience and influence cannot be quickly replaced, although some newer Members are supportive of recreational matters.

In the second instance, the number of groups which have made the case for recreation legislation before the Congress has increased. Some of these new groups, such as Friends of the Earth, have represented a strong protectionist philosophy. Now, however, additional organizations, such as the American Ski Federation, representing a different economic and development attitude toward recreation matters are coming onto the Washington scene.

The resulting interplay between the changing Congress and the changing voices for outdoor recreation interests should provide for interesting new trends in the near future.

LAND MANAGEMENT POLICY AND PROGRAM TRENDS[1]

Darrell E. Lewis[2]

There has been a shift in federal land management agencies toward less facility-oriented recreational activities. This shift is described by executive messages and legislation. Other indicators of the shift are President Carter's environmental message of 1979, establishment of additional National Recreation Trails, and a combined report to the President by the Secretaries of Agriculture and Interior which describes coordinated objectives and action plans developed by the Bureau of Land Management and the Forest Service.

In spite of the fact that land management policies and programs have recently focused on such topics as oil and gas, coal, timber, and range, there have been several key indicators of outdoor recreation trends.

President Carter's Environmental Message of August 2, 1979, contained specific directions regarding Wild and Scenic Rivers, Trails, and increased coordination between the two largest federal land managers, the Bureau of Land Management and the Forest Service. The Urban Recreation Study conducted by the Heritage Conservation and Recreation Service signals another change in emphasis. The popularity of the term "dispersed recreation" in several land management agencies signals a shift toward less facility-oriented recreational activities. Yet another indicator is the adoption of the Recreation Opportunity Spectrum by the Bureau of Land Management and Forest Service as a means of dealing with recreation within the multiple-use management perspective. In this paper, some of these key signals are identified and briefly described.

PRESIDENTIAL ENVIRONMENTAL MESSAGE OF 1979

Wild and Scenic Rivers

"Development along the banks of our rivers continues to outpace our ability to protect those rivers that might qualify for designation. This problem is particularly acute near urban areas, where there are greater demands for recreational opportunities which can partly be met by river protection.

We need to speed up the process for studying Wild and Scenic Rivers for designation and to consider the protection of rivers or parts of rivers which can protect important natural ecosystems. Moreover, the federal government should set an example of sound management for state, local, and private landowners by taking an aggressive role in protecting possible Wild and Scenic Rivers which flow through our public lands. Accordingly, I am directing the following actions be taken:

- federal land management agencies shall assess whether rivers located on their lands and identified in the National Inventory prepared by Heritage Conservation Service are suitable for inclusion in the Wild and Scenic Rivers System; if so, these agencies shall take prompt action to protect the rivers--either by preparing recommendations for their designation or by taking immediate action to protect them;

- all federal agencies shall avoid or mitigate adverse effects on rivers identified in the National Inventory; and

- the Secretary of Agriculture and the Secretary of the Interior shall jointly revise their Guidelines for evaluating wild, scenic, and recreational rivers to ensure consideration of river ecosystems and to shorten the time currently used to study rivers for designation."

These measures are currently underway and represent a considerably stronger protective stance on the treatment of possible Wild and Scenic Rivers which flow through federally administered lands.

---

[1] Paper presented at the National Outdoor Recreation Trends Symposium, Durham, NH, April 20-23, 1980.

[2] Chief, Division of Recreation and Cultural Resources, Bureau of Land Management, USDI, Washington, D.C. 20240.

National Trails

"Under my direction, the U.S. Forest Service will establish 145 additional National Recreation Trails by January 1980, achieving a goal of two National Recreation Trails in each National Forest System unit. I am directing each federal land management agency to follow the example set by the Forest Service and by January 1980 announce a goal for the number of National Recreation Trails each agency will establish during 1980 on the public lands administered by the agency. I am also directing that, by the end of 1980, a minimum of 75 new National Recreation Trails shall be designated on public land other than National Forests by the federal land management agencies.

I am directing the Secretary of the Interior, through the Interagency Trails Council, to assist other federal agencies in surveying existing trails on federal lands to determine which of those can be made part of our National Trails System and to initiate a grass-roots effort in every region of the Country to assess our nationwide trails needs. In addition, I am directing the Secretary of Agriculture, the Secretary of Defense and the Chairman of the Tennessee Valley Authority to encourage states, localities, Indian tribes, and private landholders to designate trails on their lands."

This effort has refocused land manager's attention to hiking trails across the Nation.

Coordination between the Bureau of Land Management and the Forest Service

"I am directing the Secretary of the Interior and the Secretary of Agriculture to work together to coordinate their Departments' natural resource policies and programs, particularly those of the Bureau of Land Management and the Forest Service. I am requesting the two Secretaries to develop within six months a detailed statement of coordination objectives and a process and timetable for achieving them."

This assignment resulted in the submission of a report to the President by the Secretaries of Agriculture and Interior on February 6, 1980.

The report describes coordination objectives and action plans developed by the Bureau of Land Management and the Forest Service. The report addresses the following areas:

1. Program Cycles
2. Program Development
3. Jurisdictional Transfers and Boundary Adjustments
4. Energy and Minerals
5. Common Procedures in Grazing Management
6. Sharing Facilities/Personnel/Training
7. Research
8. Public Involvement
9. Other

Of particular interest to this group is the fact that outdoor recreation policies and procedures have been identified for the formation of a topical subgroup to develop action programs.

Recreation Opportunity Spectrum

This will prove to be quite timely as the Bureau of Land Management and the Forest Service have already begun to come closer together philosophically on the basics of outdoor recreation. Thanks to the research efforts of the Forest Service, the concept of an outdoor recreation spectrum has been endorsed by both agencies and is presently being incorporated into invento planning, and management policies and procedures for both agencies.

Recreation Land Acquisition

Another recent indicator of outdoor recreation policy has been the administration's proposal to reduce the federal portion of the Land and Water Conservation Fund from $357 million available in FY 1980 to $256 million to reduce federal spending. An additional cut from $252 million to $75 million is being proposed by the President for FY 1981.

THE U.S. ARMY CORPS OF ENGINEERS RECREATION RESOURCE MANAGEMENT CHALLENGES[1]

Gerald T. Purvis[2]

This paper provides a brief legislative history of Corps responsibilities for public recreation, outlines its relationships with non-federal agencies and organizations and describes a number of environmental concerns it sees in its new outlook for management of recreation resources. A Recreation-Resource Management System is also described that contains data on the management of natural and developed resources, personnel and other relevant subjects at more than 400 Corps projects.

The purpose of this paper is to give a gen-ral overview of the Corps of Engineers and the ecreation-Resource Management Program at water esource development projects. A few selected urrent problems are outlined and presented in rief discussion.

The U.S. Army Corps of Engineers was the irst federal agency to protect public park ands when they were called on to protect the esources of Yellowstone National Park in 1886. his lasted for nearly 30 years until Congress reated the National Park Service. However, it asn't until enactment of the Flood Control Act f 1944 that the Corps actually became a major and management agency with all of the inherent isitor assistance responsibilities.

It is the policy of the Corps to provide afe and healthful recreation opportunities while rotecting and enhancing the project resources. n the original acquisition of land at civil orks installations, the Corps of Engineers btains proprietary interests only. Individual tates and their political subdivisions retain he statutory authority and inherent responsibi-ity to enforce state and local laws. Park man-gers and rangers do not have the legal authority o enforce state and local laws. Our authority s limited to issuance of citations for viola-ion of Title 36, Code of Federal Regulations. ark managers and rangers do not have the legal authority to arrest, carry weapons, or other items such as mace, nightsticks, or other similar equipment normally associated with law enforcement. Park managers and rangers cannot search or seize under this authority. Personnel may stop, but not physically detain the public while implementing these regulations. The citation authority used to implement Title 36 was enacted by Congress in 1970.

In 1976, Congress, recognizing the limited authority of the Corps in law enforcement and also the burden that these projects had placed on local authorities, enacted Section 120 of the Water Resource Development Act of 1976. This authority provided that the Corps could enter into contracts with states or their political subdivisions to obtain increased law enforcement at Civil Works water resource development projects. It is not intended that this authority diminish or otherwise limit the existing law enforcement responsibilities of the state or local law enforcement agencies. Unfortunately, the Congressional authority was limited to fiscal years 1978 and 1979 on a trial basis. Although the Corps and local authorities have praised the program as being successful, Congress has not extended that authority. We hope they will do so very shortly. We have found that this program has created better cooperation and rapport between local law enforcement officers and Corps project personnel, reduced incidents of vandalism and other disturbances, increased public's sense of security and reduced the Corps personnel's exposure to high risk situations affecting their safety and that of the public. Currently, the Senate has proposed a bill which would extend this authority.

---

[1] Paper presented at the National Outdoor ecreation Trends Symposium, Durham, NH, April 0-23, 1980.

[2] Chief, Recreation-Resource Management ranch, U.S. Army Corps of Engineers, Washington, .C. 20314.

While the Corps does not take its visitor assistance responsibility lightly, we hire our personnel for a professional job of managing project resources, not to perform law enforcement duties. We will continue to train our personnel to assist the visitor in every way possible, but maintaining a low key law enforcement image.

In 1965, the Federal Water Project Recreation Act (P.L. 89-72) was enacted requiring that full consideration be given to the opportunities, if any, that water resource projects afford outdoor recreation and fish and wildlife enhancement. This legislation also requires that, on projects authorized after 9 July 1965, 50 percent of the separable costs for development of recreation facilities be borne by a non-federal public agency and that the non-federal public agency bear the cost of operation and maintenance of the recreation.

Only two major land management agencies of the federal government are affected by P.L. 89-72; the Corps of Engineers and the Water and Power Resources Service. Other federal land management agencies continue to develop recreation facilities at 100 percent federal cost. Studies have shown that the major impact of the provisions of P.L. 89-72 is on the Corps projects. This is partly a result of the ability of the Water and Power Resources Service to transfer operation and maintenance responsibilities at their projects to the National Park Service and other Bureaus of the Department of the Interior.

Once a transfer has been made to another federal agency, the provisions of P.L. 89-72 are not applicable to that agency. A Corps project constructed outside the boundaries of a national forest, for example, is subject to the cost sharing provisions of P.L. 89-72. However, when a Corps project is constructed partially or wholly within the boundaries of a national forest, responsibilities for planning, development and management may be transferred to the U.S. Forest Service under the terms of the 1965 Memorandum of Agreement between the Secretaries of the Army and Agriculture. Those lands which are transferred to the Forest Service under such an agreement may be developed by the Forest Service without a cost sharing agreement with a non-federal agency. Those lands retained by the Corps require a cost sharing contract with a non-federal public agency prior to development of recreation facilities.

Adequate time has passed for the basic assumption of P.L. 89-72 to be tested. Although countless contacts have been made with non-federal agencies in attempts to solicit non-federal sponsorship of recreation developments at Corps projects, progress has been very limited. Since the passage of the Act, 14 years ago, only 21 contracts have been consummated on 20 Corps projects.

The National Society for Park Resources, formerly the National Conference on State Parks, and a branch of NRPA, has passed resolutions opposing P.L. 89-72 as now written. NSPR spoke for all the Directors of State Park Agencies in passing these resolutions. The main objections to the act are (1) the imposition of financial hardships on state and local agencies, and (2) the program does not function in concert with state and local objectives and priorities.

It is difficult for states to commit their legislatures to a contract which requires 50 percent of the development cost for recreation in addition to the assumption of operation and maintenance and replacement responsibilities for a 50-year period on land to which the state holds no title. Considerable objections from state and local agencies in this regard have been encountered throughout the process of trying to obtain contracts at Corps of Engineers projects. Many states have constitutional or statutory prohibitions which preclude them from entering into long-term contracts as required by Section 221 of the Flood Control Act of 1970.

Over the years the Corps of Engineers has always been successful in receiving non-federal cooperation in development and management of recreation areas when the proposal is compatible with the overall plans and objectives of the non-federal agency and within the budgetary limitations of that agency.

Since the beginning of Fiscal Year 1974 when the cost sharing principles of P.L. 89-72 were applied to further recreation development at completed water resource projects, the Corps of Engineers has entered into 113 contracts and supplemental agreements with non-federal entities.

From time to time, Congressional attention has been devoted to the provisions of P.L. 89-72 and attempts have been made to define workable amendments to the legislation. The most recent such amendment is contained in Senate Bill, S-2054. Among other things, this amendment would provide for an expansion of the minimum basic recreation and fish and wildlife areas and facilities to be provided at full federal funding. It also provides for retention of lands acquired for recreation and fish and wildlife purposes for which they were acquired as long as the lands are capable of serving the purpose for which they were acquired. The bill would also provide that when an agreement cannot be executed with a non-federal public body, the agency could develop and manage the area subject to an approved master plan to meet recreation needs. The amendment further provides for the encouragement of the development of tourist facilities by the private sector.

While no 89-72 contracts have been canelled, approximately 70 recreation areas have een returned to the Corps for operation and aintenance. In these cases the facilities were uilt at 100 percent federal cost and leased to he locals for operation and maintenance puroses. The state of Pennsylvania is currently onsidering turning six projects, now under ease, back to the Corps for O&M. Considering he limited resources available, it may become ecessary to close these areas to public use ntil the local sponsors can meet the O&M esponsibilities.

The Corps of Engineers has been committed or several years to contracting with the priate sector for a great deal of its goods and ervices. We have been relying on private conractors to perform many routine services, i.e., aily park maintenance, scheduled grounds and acility maintenance, one-time maintenance jobs, ark gate attendances, use fee collectors, and ajor repairs, etc.

In March, 1979, OMB issued a revised OMB ircular A-76 which (1) reaffirms the Governent's general policy of reliance on the private ector for goods and services, while recognizing 2) that certain functions are inherently overnmental in nature and must be performed by overnment personnel, and (3) relative cost must e given appropriate consideration in decisions etween in-house performance and reliance on rivate commercial sources.

The guidelines included in A-76 will require he Corps to review its total program of actiities and determination will have to be made how those activities will be achieved, inouse or by contracting out. Frankly, the idelines are geared to contracting out. However, there are circumstances which indicate erformance by in-house capability. In the ea of recreation resource management, we feel at we can continue to demonstrate that some f our tasks can be accomplished in-house at a st that is less than contract performance. In her words, we will contract out if it is cost fficient. This does not mean that we will get y new personnel spaces if the activity based A-76 guidelines can best be performed inouse. Additional personnel spaces may be quested from OMB if this is the case.

The A-76 guidelines will have no cause or fect on the Set-Aside Programs such as 8-a or nority contracts. It is the general policy of e Corps to ensure that small businesses, cluding those owned and managed by disadvanged persons, receive a fair share of governnt contract awards.

A number of environmental concerns are a rt of the new outlook for recreation resources nagement in the Corps.

1. The Aquatic Plant Control Program has expanded to meet problems which have become recognized throughout the Country. Research, planning, and control/operations have been increased to address biological, chemical, mechanical and integrated control techniques to major populations of obnoxious aquatic plants. Legislation has been introduced to increase the annual budgetary ceiling from $5 million to $15 million.

2. Wildlife management and enhancement of Corps projects have received considerable attention recently. Efforts are underway to assure that uniformly high quality wildlife management programs are applied consistently at Corps projects. Further efforts are underway to determine better techniques for satisfying our needs and responsibilities for mitigation of the loss of wildlife habitat and enhancement of habitat at existing projects. Many factors are, of course, involved in our reemphasis of wildlife management at our projects. The first is the character of wildlife resources of a plant community, as determined by the structural characteristics of those communities, and secondly, the characteristics of the wildlife fauna, as determined by the distribution and diversity of the various plant communities. These same characteristics, of course, also contribute to the value that an area has a recreation site. Vegetation characteristics include type, shape, height, and mix of different species. These are used to determine the effects relationship between the proposed use and wildlife of the same area.

The species in each of these communities react differently to permanent recreation development. Some species benefit, while others would suffer. From this analysis, it may be determined that two mammals and three different bird species would be impacted by recreation development. For example, these may include deer and elk, and osprey, fan-tailed pigeon, and great blue heron.

In developing a process for other Resource Use Objectives programs for wildlife analysis, a series of basic steps should be considered: (1) obtain aerial photographs of project and the immediate area, (2) use the photo interpretation to map the vegetation zones, (3) select a stratified sample of each type of vegetation zone by conducting a ground survey to include the structure and composition of the vegetation and establish wildlife in vegetation zones, (4) coordinate with state and federal resource agencies to develop the species of specific concern, determine the problems associated with those species, and to determine areas of specific use for those species, and (5) formulate an effective relationship between vegetation and wildlife to develop a plan to optimize wildlife and recreation use. From this basic analysis, we will come to a more realistic concern for the impacts of recreation on the environment.

3. Pollution abatement efforts at Corps projects continue. New facilities and rehabilitation of existing facilities to meet legislative requirements in recreation areas and at operational areas of Corps projects receive a relatively high priority within the overall mission of the Corps.

4. Lakeshore management efforts at existing projects have generally been successful in maintaining natural ecological values and providing for equitable public use at the 48,000 miles of shoreline located on Corps lakes.

5. For the past two years the Corps has participated with the National Wildlife Federation and others in the annual mid-winter Bald Eagle survey. We have found that the winter range for the Southern Bald Eagle has been enhanced by the creation of major dams on the waterways in the major flyways. These dams, in most cases, provide the only open water available in the area. Further, hydro-power projects provide food, in the form of chopped-up fish, during periods of generation.

6. The Recreation Research Program (RRP) is an on-going research and development program managed by the Waterways Experiment Station in Vicksburg, Mississippi. Each year problem statements are evaluated and prioritized; those receiving the highest priority ratings are generally funded first. On-going research projects include the development and management of a Recreation Research and Demonstration System and guidelines for the establishment of carrying capacities. Other research topics include visitor safety, operations and maintenance contracting, concessionaire opportunities, and criteria for the development of roads and sanitary facilities.

A final on-going research program being managed by the RRP involves determining what impacts the energy situation is having on visitation patterns at Corps recreation areas. A final report is now being prepared and should be available by the end of this summer. There were some declines in visitation during 1979 on some Corps projects. Overall, however, demands for Corps resources are steadily increasing. Visitation to Corps recreation areas rose by 3 percent between 1978 and 1979 despite record high gasoline prices and shortages in many areas. One obvious reason for this increase is that 80 percent of all Corps projects are located within 50 miles of a Standard Metropolitan Statistical Area (SMSA). Of these, 71 percent have metropolitan populations of 100,000 or more. Around 25 percent are either partially or wholly contained within an SMSA. Even though current data await further analysis, it looks as though the gasoline situation, by forcing people not to travel as far but stay longer, will place even greater demands on Corps recreation facilities than ever before.

The Recreation-Resource Management System (RRMS) is an automated data base which has been maintained by the Recreation-Resourc Management Branch since 1972. The RRMS contains data on more than 400 Corps of Engineers projects with an annual visitation of more tha 5,000 people. Each project in the RRMS has data on the management of natural and develope resources, personnel, and other relevant project data.

Because the RRMS was designed to be a management information system, it was substantially modified in FY 1979 to provide comparat analysis of year-to-year data since CY 1978. In addition, all Corps districts and divisions were provided with immediate access to the dat base through the use of remote terminals and a user oriented programming language. The enhancements of the RRMS allowed district and division personnel to prepare unique, ad hoc reports to assist in making day-to-day management decisions.

The Office of the Chief of Engineers uses the RRMS as a management tool and has the resp sibility to provide several federal agencies with annual reports specifically tailored for their management needs. The RRMS is also used to respond to inquiries from Congress; other federal, state, and local agencies; universiti and interested parties concerned with recreational aspects of Corps projects.

Additional information on the RRMS is available from the annual publication "Recreation Statistics" published by the Corps of Engineers.

In general, these are some of the major challenges facing the Corps in the 80's. We must find more efficient ways to manage our resources. We must not only provide for recre tion opportunities, we must protect and enhanc the project resources. With increasing legislative requirements we must also reemphasize our environmental and fish and wildlife respon bilities.

A METHODOLOGY FOR THE SYSTEMATIC COLLECTION, STORAGE, AND RETRIEVAL OF TREND DATA FOR THE U.S. ARMY ENGINEERS RECREATION PROGRAM[1]

Dennis B. Propst, Outdoor Recreation Planner[2]
U.S. Army Engineers
Waterways Experiment Station
P. O. Box 631
Vicksburg, MS

Robert V. Abbey, Outdoor Recreation Planner
U.S. Army Engineers
Waterways Experiment Station
P. O. Box 631
Vicksburg, MS

INTRODUCTION

In 1979, over 450 million recreation days[3] of use were reported at 419 Corps of Engineers lakes and other project areas. This figure represents a 2.7 percent increase in use over 1977 (424 million recreation days). The Corps and other agencies (quasi-public, state, local and other federal agencies) manage 3,175 recreation areas on a total of 11.2 million acres of land and water. The Corps manages 2,229 (70 percent) of the recreation areas and has the responsibility for managing more than 44,000 developed campsites. Other agencies, excluding concessionaires, manage 946 recreation areas with 28,000 developed campsites.

The tremendous use of such a large and diverse recreation resource has led to resource deterioration, social conflicts, and inadequate manpower in some areas. As a result, Corps managers and planners need information concerning resource carrying capacities and user preferences for various facilities and activities. Recreation behavior, however, is not a static phenomenon. Thus, managers and planners also need to be able to observe trends in recreation preferences and behavior patterns over time. This paper describes current and proposed information systems developed to assist Corps personnel in monitoring such trends.

CORPS OF ENGINEERS INFORMATION SYSTEMS

Figure 1 represents the functional relationships among the various information sources and systems that influence the Corps-wide recreation programs. The arrows denote directions of information flow. Figure 1 represents the conceptualization upon which this paper was based. Thus, further discussion will focus on each of the elements of this figure. Actual data will be presented where appropriate to exemplify the types of recreation trend information being monitored.

CORPS-WIDE RECREATION PROGRAM

The Corps-wide recreation program includes all elements ranging from the individual projects and OCE are two more administrative layers, the Districts and the Divisions. There are 10 Divisions in the contigious 48 states with several Districts in each Division.[4] For this discussion, the pertinent line function running through OCE to the Divisions, to the Districts, and finally to the projects is the Recreation Resource Management Branch (RRMB). In OCE, personnel in this Branch are primarily

---

[1] Paper presented at the National Outdoor Recreation Trends Symposium, Durham, NH, April 20-23, 1980.

[2] Dr. Propst is on temporary assignment under the terms of an Intergovernmental Personnel Act Agreement between the Waterways Experiment Station and Virginia Polytechnic Institute and State University, Blacksburg, VA 24061.

[3] A standard unit of use consisting of a visit by one individual to a recreation development or area for recreation purposes during any reasonable portion or all or a 24-hour period.

[4] The one exception to this generalization is the New England Division, which has no Districts.

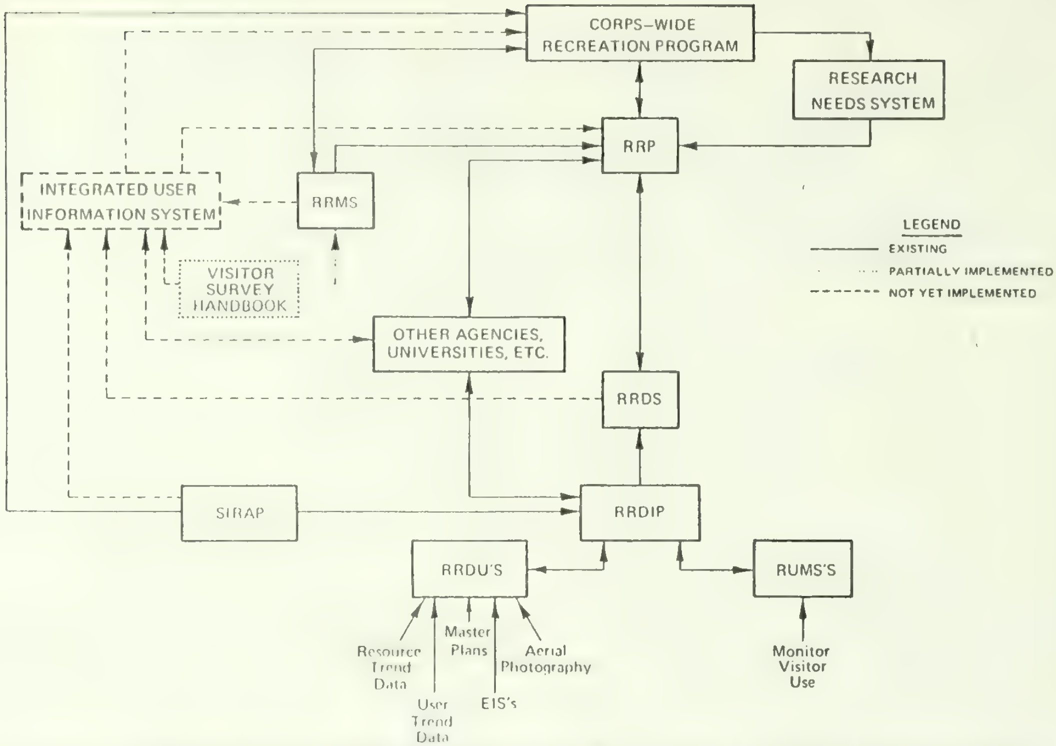


Figure 1. Relationships among information sources and systems in the Corps of Engineers recreation program (arrows denote direction of flow of information). Acronyms are defined in the text.

involved with developing field guidelines, storing and retrieving data, and disseminating information. Personnel in the RRMB's of the Districts and Divisions are involved with developing field guidelines, but also have duties in recreation planning and operations. Personnel at the project level have the responsibility for recreation site management and handling daily operations and maintenance functions, which may vary from project to project.

To help solve recreation design and management problems and to formulate policy, the Corps-wide recreation program receives information from a wide variety of sources. Three of the existing (solid line) sources are illustrated in Figure 1. First, the System of Information Retrieval and Analysis for Planners (SIRAP) was developed by OCE to assist District and Division planners. The SIRAP is a computerized system containing such census and population data as income and employment, demographics, city and county information, and economics.

Second, the Recreation Resource Management System (RRMS) is an automated system for processing recreation data for each project having an annual visitation of 5,000 recreation days of use or more. The RRMS provides for the entry, annual update, scheduled reporting, and manipulation of standardized data fields. The RRMS contains over 450 project variables ranging from monthly visitation counts to the number of unpaved road miles. The data presented in the introductory paragraph of this paper are examples of the types of information found in the current RRMS data files. OCE manages this system, using its contents for nationwide reports and for providing data to other agencies, organizations, and individuals. Field elements (i.e., project, District and Division personnel) not only enter data into the RRMS but also use such data to help make planning and management decisions. This two-way flow of information is represented by the double-pointed solid line in Figure 1.

Third, the Corps-wide recreation program receives information from the Recreation Research Program (RRP), an element administered by the Corps' Waterways Experiment Station in Vicksburg, Mississippi. The RRP is composed of personnel with expertise in recreation planning and design, resource management, park administration, economics, research design, and social sciences.

RECREATION RESEARCH PROGRAM

An important mission of the RRP is to conduct research, the results of which are reponsive to the needs of field personnel. To nsure that this goal is achieved, OCE imple- ented a Research Needs System for all Corps esearch elements, including the RRP. Accord- ng to the Research Needs System, anyone in he Corps can submit for review a problem hich he or she feels needs to be researched. nce each year these problems are reviewed by he field and are prioritized. Generally, hose problems receiving the highest ratings re funded for research. Thus, the RRP usu- lly conducts research only on high-priority ield problems.

To carry out its research and information ransfer functions, the RRP receives informa- ion from a wide variety of sources that in- luded OCE, Corps field elements, the RRMS ata base, other agencies, universities, and rivate organizations. Once research on a iven topic is completed, the results are isseminated to the field in a form suitable or implementation. Success of the RRP is easured primarily by the use of research indings rather than by the production of re- orts and publications. However, the RRP also roduces technical reports and publications or distribution to OCE, Corps field elements, ther agencies, and universities.

The RRP does not directly input data nto the RRMS but may, through research, in- luence the methods of data collection at he project level and the types of information hich the RRMS contains. For instance, ischon and Wyatt (1979) of the Midwest Re- earch Institute produced "A Handbook for onducting Recreation Surveys and Calculating ttendance at Corps of Engineers Projects" or the RRP. The need for such a handbook rew out of the recognition that each Corps istrict and project had essentially devel- ped its own procedures for collecting isitation data for the RRMS. Other major roblems included using outdated load factors, ouble-counting recreation vehicles within a roject, and disregarding proper sampling rocedures. The new handbook offers a stan- arized methodology for counteracting these nd other problems. Errors in collecting isitation data have not been entirely elimi- ated because numerous projects and Districts ave not yet implemented the new procedures dotted line in Fig. 1). However, as the andbook becomes more widely used, visitation igures entered into the RRMS should become ch more reliable than in the past.

RECREATION RESEARCH AND DEMONSTRATION SYSTEM

As stated previously, the RRP conducts search on field-related problems. Those oblems of highest priority are funded for search by OCE and administered by the RRP as work units to be completed by a specific date. Examples of such work units include "Cost Efficiency of Methods of Operating and Maintaining Corps Recreation Areas" and "Planning and Design Standards for Recreational Roads and Sanitary Facilities". Another work unit, of primary concern to this paper, is the Recreation Research and Demonstration System (RRDS).

The RRDS was initiated in October of 1978 with some of the following goals:

a. To monitor national and regional trends in the quantity and nature of use of Corps recreation resources and the biological, physical, economic, and social impacts associated with such use.

b. To serve as a focus for research and testing in all recreation and natural resource subject areas for which the Corps has responsibility.

c. To provide outdoor laboratories where new methods, structures, designs, and management techniques can be tested and results demonstrated.

d. To meet the requirements of as many of the RRP work units as possible.

e. To attract research interest on the part of other federal agencies, state agencies, universities, and other research organizations.

f. To draw the understanding and support of those Corps operating elements which the RRDS is designed to serve.

To meet these goals, the RRDS is composed of 25 Recreation Research and Demonstration Units (RRDU's) and 9 Recreation Use Monitoring Stations (RUMS's). With only one exception, all components of the RRDS are administered by the Corps. The exception is Lake Amistad National Recreation Area, which is under National Park Service (NPS) jurisdiction. The locations of the RRDU's and RUMS's are shown in Figures 2 and 3, respectively. Each RRDU and RUMS is either an entire Water Resources Development Project or an officially designated portion of such a project.

Projects included in the RRDS were selected to be representative of a wide range of geographic, biological, physical, social, administrative, and operational conditions found at Corps projects nationwide. A primary rational for the establishment of the RRDS is that individual research projects will be able to utilize and in turn contribute a common data base, thereby realizing savings both in

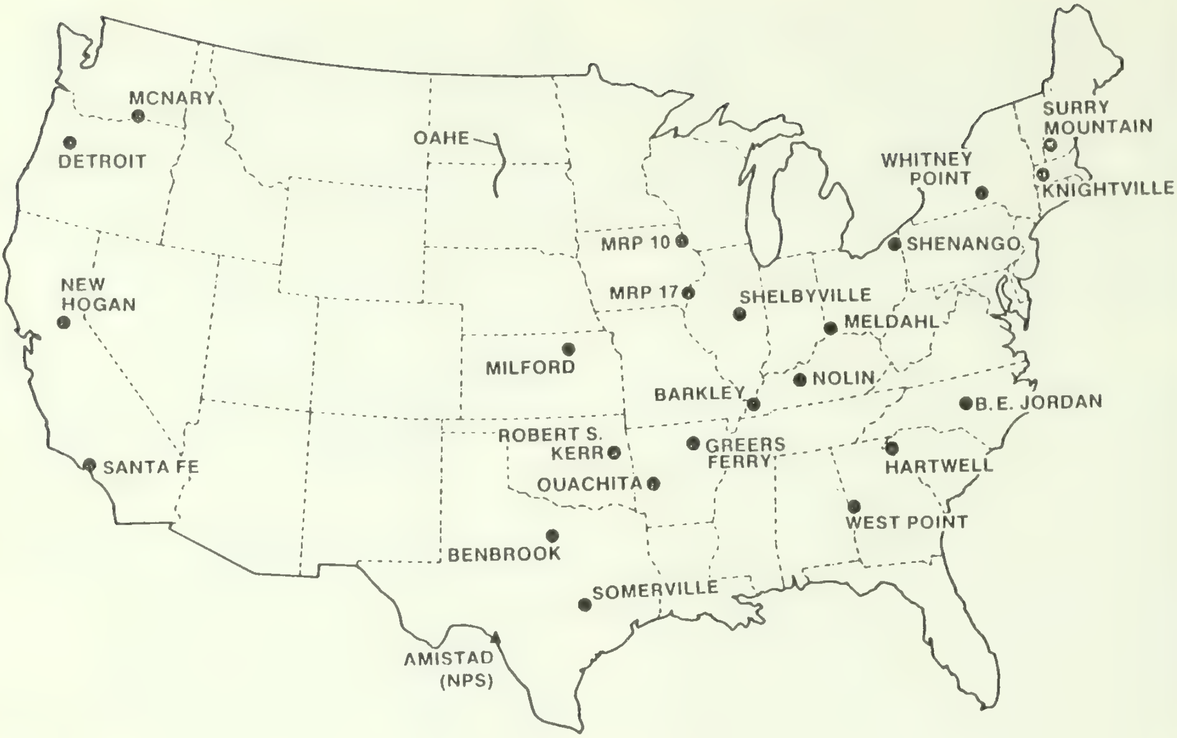


Figure 2. Locations of Recreation Research and Demonstration Units.

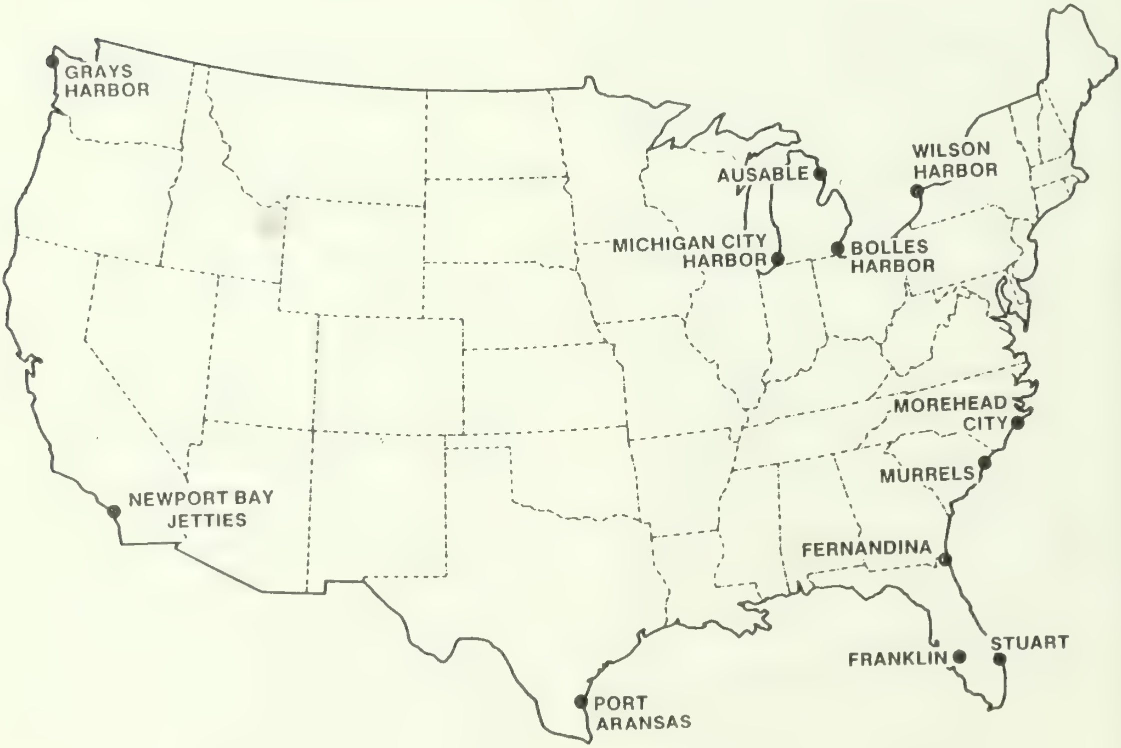


Figure 3. Locations of Recreation Use Monitoring Stations.

time and money.

The RUMS's include such Corps projects as ocean jetties, waterways, and harbors. One reason for including the RUMS's as part of the RRDS is that they are not included in the RRMS. Thus, annual Corps of Engineers visitation data do not include the tremendous use incurred at some jetties, waterways, harbors, and other such developments. One future task of the RRP is to develop a methodology for visitation trends at areas such as these RUMS's where access is not tightly controlled.

The RRDU's include the conventional multi-purpose reservoirs, navigational reservoirs with locks, dry reservoirs, modified natural lakes, and local flood-protection reservoirs. Detailed recreation data on each of the RRDU's is contained within the RRMS data base. However, such data are not available on a trend basis. That is, the RRMS contains the current year's data only. Each year the data from the previous year are erased from the computer files, thus making the chronological comparison of trend data difficult and inefficient.[5] It is for this reason that the RRP staff is currently attempting to develop special forms, identify key variables, and implement an automated system for monitoring national and regional trend information.

RECREATION RESEARCH AND DEMONSTRATION INFORMATION PROGRAM

As Figure 1 indicates, the RRP staff administers the RRDS, and in turn the RRDS is supported by the Recreation Research and Demonstration Information Program (RRDIP). Briefly, RRDIP is a program for the systematic collection, storage, manipulation, retrieval, and display of detailed information concerning the 25 RRDU's and 9 RUMS's.

For purposes of classification, the data contained in the RRDIP are divided into five components: natural, man-made, economic, social, and institutional environments. To stratify the data even farther, four geographic divisions were chosen: within project boundary, physical impact zone, economic impact zone, and recreation market zone. The combination of five components and four geographic divisions results in a matrix of 20 primary cells, the basic conceptual framework for RRDIP. Of course, there are substantial differences in the types and quantity of data that will occupy each cell. Some of the cells await the results of ongoing and future research.

The following steps are necessary for making the RRDIP operational:

a. Develop RRDU catalogs

b. Analyze District file information

c. Fill in gaps in the RRDIP data cells

d. Routine management of the RRDIP.

The first step, development of RRDU catalogs, has already been completed. The initial catalogs were limited to existing information primarily from maps, master plans, environmental impact statements (EIS's), SIRAP, other agencies, universities, and a recreation facilities inventory conducted by the RRP staff in the summer of 1979. The data are cataloged according to the 20 data cells previously described and are bound in large looseleaf notebook for ease of addition and revision. These catalogs of information are available for loan to researchers as they are needed. If funds become available, some of the data in these catalogs may be computerized, thereby increasing the ease of access. Similar catalogs for the RUMS's are not yet available.

Once key variables are identified and final methodologies are chosen, both resource and user trend data will be continual additions to the catalogs. Preliminary methodologies now being tested along with some user trend data are presented below.

The second step, analysis of District file information, has also been completed. During this step, the RRP staff obtained from each RRDU additional information such as aerial photography and reproducible drawings of recreation-area developments. Some of this information has also been incorporated into the RRDU catalog data cells. Another product of this analysis was the identification of those cells with significant gaps in data.

The third step will consist of filling in gaps in the RRDIP data base with the results of ongoing or future research. A major source of such results will be the RRP work units. Results generated by other Corps elements, other agencies, and universities will also be incorporated into the RRDIP catalogs.

The final step is routine management of the RRDIP data base. Included in this step will be such tasks as shifting from manual to computer processing of some of the data elements, redefining some of the data cells if necessary, and adding new information to the data cells.

The primary objective of the RRDIP is the support of research and demonstration; the primary users are intended to be researchers. However, the RRDIP is obviously not oblivious to field needs. The RRDIP catalogs are made available to District and project personnel as aids in administering the RRDU's. Moreover, many of the RRP research work units will use the RRDIP data to find better ways to plan and manage Corps recreation and other natural resources. Third, the trend information to be gathered will be of value to Corps planers, managers, and policy makers at all levels.

---

[5] However, it is expected that from this year forward, historical data will be retained in the RRMS.

MONITORING OF TREND DATA

One of the objectives of the RRDIP is to "accept regularly generated measurements of key factors of the recreation and related natural resources environment and to report these data in timely fashion as trend information". To meet this objective, members of the RRP staff began a pilot recreation monitoring program during the summer of 1979 at selected campgrounds within the Lake Ouachita (Arkansas), West Point (Georgia/Alabama), and Shenango (Pennsylvania) RRDU's. The monitoring program was designed to select sample areas and to test a proposed recreation use-impact monitoring methodology.

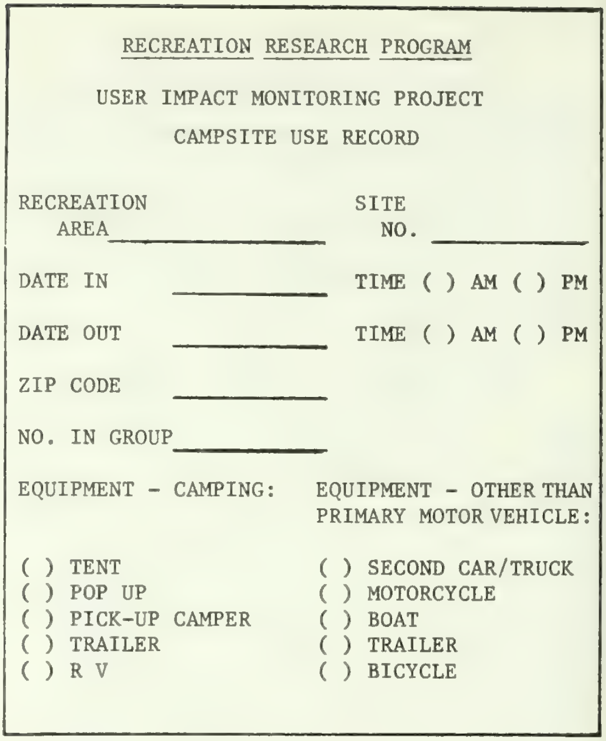
Vegetation and Soil

One field test consisted of sampling various parameters of soil and vegetation in order to establish a data base for subsequent sampling. These parameters included vegetative species composition, growth habits, percent coverage, and erosion. In addition, permanent photo plots were established, and litter (trash, paper, etc.) counts taken at each sample location. Since this first effort resulted in the establishment of a data base, it will require additional testing before any meaningful conclusions can be drawn. Additional methodological tests are planned for the summer of 1980.

Campsite User Impact

Another concern of this pilot monitoring program was how to monitor effectively the number of recreation days of use per campsite, type of equipment brought to the site by users, and occupancy preference. Accurate information to assess the effects of recreation visitors on the environment is extremely important to the success of the monitoring program.

Although the Corps of Engineers already uses a standardized campground receipt form at each of its fee camping areas, the information derived from the form was not detailed enough to be of substantial value. The RRP staff concluded that a supplementary campsite registration form (Fig. 4), completed by the campground gate attendant, would be the most effective method of recording needed data and should be tried on an experimental basis. Most of the requested information would be obtained from observation, with the exception of zip codes and time departure.



RECREATION RESEARCH PROGRAM

USER IMPACT MONITORING PROJECT

CAMPSITE USE RECORD

RECREATION AREA ____________ SITE NO. ____________

DATE IN ____________ TIME ( ) AM ( ) PM

DATE OUT ____________ TIME ( ) AM ( ) PM

ZIP CODE ____________

NO. IN GROUP ____________

EQUIPMENT - CAMPING:	EQUIPMENT - OTHER THAN PRIMARY MOTOR VEHICLE:
( ) TENT	( ) SECOND CAR/TRUCK
( ) POP UP	( ) MOTORCYCLE
( ) PICK-UP CAMPER	( ) BOAT
( ) TRAILER	( ) TRAILER
( ) R V	( ) BICYCLE

Figure 4. Initial supplementary campsite registration form.

Initial Findings

The initial phase of the user impact study has been completed, and the data obtained from the supplementary registration forms have been compiled (Table 1). One major finding which emerges from Table 1 is the preponderance of the use of tents over other types of camping equipment in two of the three RRDU's. This finding is somewhat clouded by the fact that some camping groups possessed more than one type of equipment (e.g., a pickup camper and a tent). This is why the column percentages adjacent to "camping equipment" add up to more than 100. Future recording forms (to be discussed later) will distinguish between groups with more than one and groups with only one type of camping equipment. Other notable results include the large percentage of second vehicles at all three campgrounds and the relatively high percentage of bicycles. All these findings have direct planning and management implications, especially when the same data are collected over a period of several recreation seasons and significant trends are identified.

Table 1

Recreation Variables Monitored at Three Corps Campgrounds During the Summer of 1979 as Part of the Pilot Recreation Use Monitoring Program[a]

Variables Monitored	Amity		Denby Point		Shenango		Total	
	No.	%	No.	%	No.	%	No.	%
Camping Equipment[b]								
Tent	283	28	83	56	155	50	521	36
Pop-up Camper	140	14	18	12	29	9	187	13
Pick-up Camper	127	13	38	26	42	14	207	14
Camping Trailer	371	37	22	15	38	12	431	30
RV[c]	145	14	20	13	45	15	210	14
Other Equipment[d]								
2nd Vehicle	328	33	46	31	126	41	500	34
Motorcycle	20	2	5	3	15	5	40	3
Boat	450	45	86	58	65	21	601	41
Bicycle	110	11	12	8	51	17	173	12
No. Camping Groups	1,003.00		149.00		309.00		1,461.00	
No. Camping Visitors	3,397.00		584.00		1,293.00		5,274.00	
Avg. No. Persons/Group	3.39		3.92		4.18		3.61	
No. Rec. Days Spent/ Group[e]	3,983.00		594.00		872.00		5,449.00	
Avg. Length of Stay/Group (in Rec. Days)	3.97		3.99		2.82		3.73	
Total Rec. Days Spent[f]	13,846.00		2,330.00		3,646.00		19,462.00	

[a] The three campgrounds and dates of monitoring were: Amity Campground (West Point Reservoir), 14 May-3 September; Denby Point Campground (Lake Ouachita), 20 June-3 September; and Shenango Camping Area - Phase IV (Shenango Reservoir) 24-30 May, 1-14 July, and 20-22 July.

[b] Percentages represent the number of groups utilizing a particular type of camping equipment. Column totals exceed 100 percent because, in many cases, each group had more than one type of camping equipment (e.g., a tent and a trailer).

[c] Vans were recorded in the RV category.

[d] Column totals are less than 100 percent because not all groups possessed some type of other equipment.

[e] A recreation day is a visit by one person during any portion or all of a 24-hour period. These figures were determined by summing across all groups the number of entire and partial days each group stayed.

[f] For this table, total recreation days spent were determined by multiplying the number of camping visitors by the average length of stay per group.

The advantages of such a monitoring program are numerous. The additional information generated by the use form will be beneficial to both RRDU planners and resource managers. For instance, some of the data could be used for economic demand modeling and predicting visitor use without the added burden of having to fund and administer a special survey.

Comparison of several years' data with such secondary data as nationwide sales of recreational vehicles will provide a reliable basis for identifying both national and local trends in recreation use patterns, information that is lacking in most Corps District Offices.

Revised Registration Forms

One disadvantage of the form shown in Figure 4, the inability to separate groups with more than one type of equipment from those with only one, has already been discussed. Another disadvantage was that there were not enough categories for all the different types of equipment being use. For these reasons, this special-use form has been revised (Fig. 5) and will be further tested in other Corps-operated fee campgrounds during the summer of 1980.

PROJECT __________ DATE __________

CAMPSITE USE RECORD

REC AREA ______ SITE NO. ______ ZIP CODE _______

NO. IN GROUP_______ LENGTH OF STAY ______

IS THIS YOUR PRIMARY DESTINATION ______ OR

STOPOVER FOR LONGER TRIP ______?

HOW MANY TIMES DID YOU VIST THIS AREA LAST YEAR? _________________

PRIMARY VEHICLE

( ) CAR
( ) TRUCK
( ) VAN
( ) MOTORHOME (INCLUDES CONVERTED BUSES)
( ) OTHER _____________

EQUIPMENT (CAMPING)

( ) TENT
( ) POP-UP TRAILER
( ) VAN
( ) PICKUP CAMPER
( ) TRAVEL TRAILER

EQUIPMENT (NONCAMPING)

( ) SECOND CAR/TRUCK (NON 4 WHEEL DRIVE)
( ) 4 WHEEL DRIVE VEHICLE
( ) SAILBOAT
( ) CANOE/KAYAK/RAFT
( ) POWERBOAT
( ) BOAT TRAILER
( ) BICYCLE
( ) OTHER ____________

Figure 5. Revised supplementary campsite registration form.

The amount of extra paperwork to be performed by the gate attendants, often retired couples working on a contract basis, was considered in the derivation of the forms. The collection of the information for the original form (Fig. 4) did not prove to be overly burdensome during the recent pilot test; thus, the expanded form (Fig. 5) is not expected to pose any serious problems, especially as gate attendants become accustomed to its use. In addition, a detailed set of instructions and definitions will accompany the new form, thereby eliminating some of the uncertainties that the gate attendants face in categorizing types of equipment and other information.

Another form for recording use data besides the forms shown in Figure 5 will also be tested during the summer of 1980. This form is simply a standard IBM computer card that has perforations for each number in each column. Instead of someone keypunching the data onto IBM cards, gate attendants will use a stylus to punch out the perforated sections in the card. For ease of location, the names of all the variables shown in Figure 5 will be printed above the appropriate columns. If gate attendants find this procedure simple enough it will have the added advantage of saving one step in the data coding process.

TREND MONITORING AND THE ENERGY SITUATION

The RRDIP will be of obvious value to planners and resource managers. However, as previously stated, a primary purpose of the RRDIP is to support research and demonstration. The user-impact monitoring program now being tested provides one good example of how the RRDIP will benefit researchers.

At the beginning of the current fiscal year, the RRP staff began research on a new work unit concerning the effects of the energy crisis on the Corps recreation program. The objectives of this work unit were (1) to determine changes in visitation patterns resulting from the increased cost and decreased availability of motor fuel and (2) to determine the regional and local impacts of such changes on facility and personnel requirements.

To meet the work unit objectives, the RRP staff planned to establish trends for several visitation parameters including origin, destination, frequency, duration, type of equipment used, and group size. However, it was soon apparent that either these data were of poor or unknown quality or, in most cases, simply did not exist and would be too expensive or time-consuming to collect. Therefore, a recommendation has been made to stop progress on this work unit, prepare a report summarizing secondary data sources (e.g., U. S. Trend Data Center) indicative of trends, and redefine the goals of the work unit so that it may be successfully completed at a later date. The point is that implementation of the RRDIP, with its inherent capabilities for collecting, storing, and monitoring trend data, will enable a study of this nature to be conducted in only several months and will produce more reliable data at a considerable savings in cost.

DEVELOPMENT OF AN INTEGRATED RECREATION USER INFORMATION SYSTEM

By now the reader should be impressed with the fact that, within the Corps of Engineers recreation program, there are a wide variety of information systems that contain information from diverse sources and serve many different clients. By themselves, these systems cannot, nor were they intended to, serve the needs of every possible user. For example, the RRMS contains only a portion of the recreation information required by Corps planners and managers. This is because the RRMS was originally designed to support appropriations requests. Once fully operationalized, the RRDIP will contain much detailed information from many different sources besides the RRMS. However, the RRDIP will be based entirely upon a small but fairly representative sample of Corps projects, not the entire system. The need to integrate all the available sources of data into one supplemental user information system and the means of implementing such a system are found in a report prepared for the RRP by Midwest Research Institute (Mischon and Wyatt, 1978).

The relationship of this integrated user information system to existing systems and administrative elements is shown in Figure 1. As indicated by Figure 1, the integrated user information system would be a large, computerized data-management program that interfaces data from the RRMS, RRDS, SIRAP, other agencies, universities, and research organizations. The system would be interactive and capable of responding to the needs of field personnel, the RRP, researchers, and other agencies. One important aspect of the system would be the continual input of annual data regarding recreation use patterns. Such information would enable Corps personnel to spot changing leisure patterns and forecast the effects of these trends. Once implemented, this system would simplify the monitoring of such phenomena as the effects of the energy crisis on visitation.

SUMMARY

A good deal of text in this paper was devoted to a discussion of the functional elements in Figure 1. However, a total picture of all Corps recreation information sources and systems was required to indicate where recreation trend data will be collected and utilized by various Corps elements. Such a discussion was also felt necessary because of the relative newness of the Corps' Recreation Research Program and its associated work units.

The Corps-wide recreation program is composed of OCE's Recreation Resource Management Branch and corresponding line elements in the field (i.e., Division, Districts, and water resources development projects). The RRP has no line authority over the field but exists in a different chain-of-command as an element whose primary function is to conduct field-applied research and disseminate results in a useable form. To ensure that Corps research elements, such as the RRP, conduct only field-applied research, OCE developed a Research Needs System. Through this system, the RRP receives funding for only those research work units given high priority ratings by the field.

One of the first work units for which the RRP was given responsibility was the Recreation Research and Demonstration System (RRDS). The backbone of this system consists of 24 Recreation and Research Demonstration Units (RRDU's) and 9 Recreation Use Monitoring Stations (RUMS's) selected to be representative of Corps' projects nationwide. The data system supporting the RRDS is called the Recreation Research and Demonstration Information Program (RRDIP). A major purpose of the RRDS is to identify key variables indicative of recreation trends and then to develop appropriate methodologies for monitoring such trends. One method of monitoring developed campground use, the supplemental form shown in Figure 4, has received limited field testing. Problems that were identified during initial testing led to the development of a new form (Fig. 5) to be tested at a number of campsites in the summer of 1980. Major advantages of these forms include a heavy reliance on observation for filling out the forms and the generation of reliable data that can be used to document national, regional, and local recreation trends needed for planning and management purposes.

Another work unit, the effects of fuel shortages and prices on visitation, was used as an example of the need to collect reliable trend data. It was concluded that development and implementation of methodologies for monitoring trends at the 25 RRDU's will make the completion of this and other work units more efficient in terms of reliability, time, and dollars spent.

The need for a central location for the interfacing of recreation use data from a wide variety of sources led to the recommendation and plan for an integrated user information system. This is the only element of Figure 1 not yet implemented. Again, a primary function of this system will be to monitor trends in recreation use. However, the integrated user information system will contain data from the entire Corps recreation program, not just the 25 RRDU's, and from various secondary sources not currently being used by the RRDS. Such a system will be of obvious benefit to both researchers and field personnel.

LITERATURE CITED

Micshon, Raymond M. and R. Chris Wyatt. 1978. Development of improved Decision-Oriented Recreation User Information System. Technical Report R-78-2, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

__________. 1979. A Handbook for Conducting Recreation Survey and Calculating Attendance at Corps of Engineers Projects. Technical Report R-79-1, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Abbey, Robert V., 1979. Pilot Recreation Area Monitoring Project: Preliminary Results. Unpublished Report. U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Coughlin, Robert E., David Berry, and Pat Cohen. 1978. Modeling Recreation Use in Water-Related Parks. Technical Report R-78-1, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Headquarters, Department of the Army. 1977. Recreation Resource Management System. Engineering Regulation 1130-2-414, Washington, D.C.

Propst, Dennis B. 1980. Impact of Energy Crisis on Corps of Engineers Recreation Program: A Status Reprot. Unpublished Memorandum for Record. U.S. Army Waterways Experiment Station, Vicksburg, MS.

FORECASTING TRENDS IN OUTDOOR RECREATION ACTIVITIES ON A MULTI-STATE BASIS[1]

Vincent A. Scardino
ABT Associates Inc.

Josef Schwalbe, Ph.D.
ABT Associates Inc.

Marianne Beauregard
ABT Associates Inc.

INTRODUCTION

Since a substantial amount of recreation planning takes place on a statewide basis, it is essential to have reliable information and forecasts of recreational needs on a state level. However, most of the recreation research over the last few years have used either national survey data, statewide data or site specific information. Each of these methodologies has severe limitations for projecting recreation participation on a statewide basis. Information based on national surveys, due to lack of a sufficient number of observations per state, can provide only limited information regarding recreational patterns for individual states. Alternatively, state survey efforts lack a uniform survey methodology by which results from several states can be compared. Thus, survey results from several states, unless the data were collected as part of a larger effort, can not be used to forecast the necessary interrelationships and travel patterns among neighboring states which are essential for understanding state recreational patterns. Finally, site specific data can only be used to forecast recreation at isolated sites, although such results have been used to project participation at similar sites.

Clearly, what is needed are methods for projecting recreational behavior on a regional basis so that planners from individual states, can take account of changing patterns and desires from neighboring states which will affect participation in their own states and vice versa. Only by incorporating the complex set of interactions among states can planners in any particular state obtain an accurate picture of recreational participation within his/her own state.

The research effort described below represents one of the few attempts at regional recreational modeling for the New England and New York region.[2] The states are, for the most part, geographically small. The area contains both heavily urbanized centers and rural areas. There are large topographical differences within easy traveling distance offering a wide variety of recreational activities within the region; these, and other reasons, imply that recreationists may easily travel among neighboring states. To accurately understand and project recreational trends within the region, and more importantly for individual states within the region, some form of regional model is essential. The model that was developed will be shown to be a flexible tool capable of forecasting several dimensions of recreational participation as well as spatially distributing participants throughout the region. This paper is divided into three sections: The first section describes the forecasting model; the second summarizes the steps and input data necessary to run the model; the last section presents results for 1985 for two recreation activities, Swimming in Salt Water and Hiking and Wilderness Camping.

DESCRIPTION OF THE FORECASTING MODEL

The model used to project recreation in the New England-New York area was developed by ABT Associates, Inc. under contract to the Commonwealth of Massachusetts to analyze current outdoor recreation patterns within the region and to advance the state-of-the-art in regional recreational forecasting.[3] The model that was developed, while being a very flexible analytic tool, is specific to the New England-New York area, although the methodology is generalizable to all regions of the country.[4]

---

[1] Paper presented at the National Outdoor Recreation Trends Symposium, Durham, NH, April 20-23, 1980.

[2] Other regional models exist for the Pacific Northwest region.

Overall, the model is capable of forecasting recreational participation for sixteen different activities;[5] for each activity the model can predict the number of user days of overnight trips and day trips. In addition, the model can also disaggregate activity days into the total number of participants, the frequency of participation and the duration of participation (duration of participation, in activity days applicable only for overnight trips). Finally, the model makes each of these projections by activity, for subregions within the New England-New York region and distributes the resulting participants from any given subregion to each of the remaining subregions within the entire area.

In total there are 79 regression equations in the forecasting model for the 16 different summer outdoor recreation activities. The forecasts for each activity are divided into forecasts for day trips and overnight trips. The distinction between overnight and day trips is stressed because it is felt that the underlying dynamics between the two types of trips are different. Day trips usually involve less travel than overnight trips and usually involve participation in fewer activities. In contrast, for overnight trips the primary goal is the participation in a recreational trip, rather than a single or few well-defined activities. Thus, there are far more combinations of activities engaged in during an overnight trip and it is more difficult to relate a single overnight outing to a single activity.

One of the important goals of the forecasting model was the ability to project recreational participation from subunits of the entire region and then allocate the participation from each subunit to the remaining areas. Thus, the whole study area was divided into 15 geographic subregions so that movements from origins to destinations could be analyzed.[6] Participation was, therefore, projected on a subregional basis for each activity and the resultant activity days originating in each subregion were distributed to all the 15 possible destinations. It is important to note that the 15 subregions are both potential origins and destinations for each activity (for both overnight and day trips). It is also important to note that the model is restricted to forecasting activity participation for only those participants originating from within the region; the model is capable of estimating the number of recreationists that leave the subregion but is not able to project the number and destination of participants that enter the region from elsewhere.

The actual structure of the model is described in Exhibit 1. The model is divided into a day trip model and an overnight trip model,[7] and is estimated for the most part separately for each activity. For both types of trips, day trips and overnight trips, the model is further disaggregated into seven equations, three equations for day trips and four equations for overnight trips, which separately estimate several parameters of participation and together determine total number of activity days at each possible destination within the subregion.[8]

Each of the main equations of the model provide different information thought to be important for recreational planning purposes. The are:

- the probability of participation in a given activity during a given summer

---

[3] For a detailed description of the model, see the ABT Associates report Analysis and Computer Modeling of Summer Outdoor Recreation Activities in the Northeast. Only a general overview of the model is presented in this paper.

[4] Eastern New York was combined with New England to comprise a region because there is obviously a great deal of travel between New York and New England.

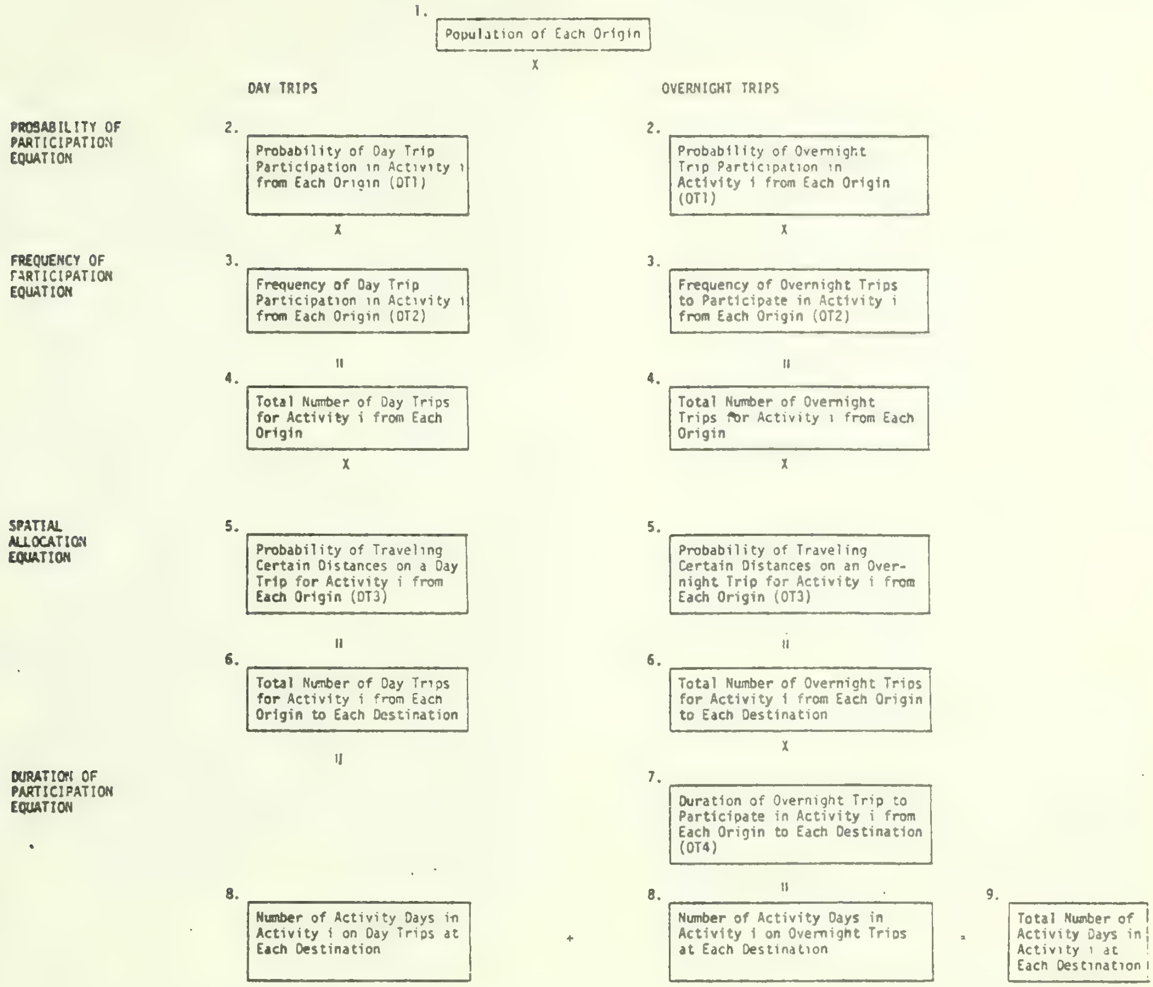
[5] The sixteen activities are Swimming in Outdoor Pools, Swimming in Fresh Water, Swimming in Salt Water, Hiking and Wilderness Camping, Campground Camping, Tennis, Golfing, Bicycling (for pleasure), Canoeing, Sailing, Power Boating, Nature Walks, Fishing, Sightseeing (by motor vehicle), Visiting Fairs, Zoos and Amusement Parks, and Watching Outdoor Sports.

[6] The breakdown of the entire region was done by state, with representatives from the individual states determining the subregions which best suited their needs.

[7] For the most part the equations for day trips and overnight trips are estimated separately, although some linkages do exist since day trip variables are used in the overnight equations.

[8] It is important to realize that the output of the model is measured in activity days. An activity day is defined as the occurrence of participation, by an individual, in a given activity during a single day. Thus, it is possible that several activity days can occur in a single 24 hour period. The model, therefore, does not project the actual amount of time engaged in for an activity. Rather, it predicts the number of occurrences, measured as an activity day, of participation.

EXHIBIT 1: OVERVIEW OF THE MODEL


1.
Population of Each Origin
X
DAY TRIPS
OVERNIGHT TRIPS
PROBABILITY OF PARTICIPATION EQUATION
2.
Probability of Day Trip Participation in Activity i from Each Origin (DT1)
2.
Probability of Overnight Trip Participation in Activity i from Each Origin (OT1)
X
X
FREQUENCY OF PARTICIPATION EQUATION
3.
Frequency of Day Trip Participation in Activity i from Each Origin (DT2)
3.
Frequency of Overnight Trips to Participate in Activity i from Each Origin (OT2)
=
=
4.
Total Number of Day Trips for Activity i from Each Origin
4.
Total Number of Overnight Trips for Activity i from Each Origin
X
X
SPATIAL ALLOCATION EQUATION
5.
Probability of Traveling Certain Distances on a Day Trip for Activity i from Each Origin (DT3)
5.
Probability of Traveling Certain Distances on an Overnight Trip for Activity i from Each Origin (OT3)
=
=
6.
Total Number of Day Trips for Activity i from Each Origin to Each Destination
6.
Total Number of Overnight Trips for Activity i from Each Origin to Each Destination
=
X
DURATION OF PARTICIPATION EQUATION
7.
Duration of Overnight Trip to Participate in Activity i from Each Origin to Each Destination (OT4)
=
8.
Number of Activity Days in Activity i on Day Trips at Each Destination
+
8.
Number of Activity Days in Activity i on Overnight Trips at Each Destination
=
9.
Total Number of Activity Days in Activity i at Each Destination

- the frequency (the number of separate occurrences) of participation within a given season for a given activity

- the spatial allocation between where a recreation trip originates and where it culminates

- the duration (measured in activity days) spent participating in particular activity (applicable only to overnight trips).

The first three equations are estimated separately for day trips and overnight trips; the fourth equation is applicable only to overnight trips. All equations are activity specific, except the last two overnight trip equations which are trip specific since it was found to be impossible to separate out the individual influences of specific activities from the decision to take an entire trip.

Again referring to Exhibit 1 the linkages can be described.

The first output of the model is the determination of the total number of trips originating at each origin (Box 4). This is accomplished in two steps. The first step estimates the probability of a person, at a specific origin, participating in a given recreational activity (Box 2). The second equation, using only those who have participated in a given activity, determines the number of trips they take (Box 3).

These equations are used to predict total trips from each origin. If values of the independent variables from each origin are inserted into the two equations, the probability and frequency of participation from each origin can be predicted. This information is combined with the population of each origin, and total number of trips from each origin is obtained by multiplying the three values.

Once estimates of the total number of trips from each origin are obtained, the second part of the model allocates the total trips among the various destinations (Box 6).[9] The last equation of the model, applying only to overnight trips, estimates total number of activity days per overnight trip at a given destination.

The output at this stage is an equation predicting total number of activity days for a given activity (Box 7). When the total number of activity days from day trips is combined with the total activity days on overnight trips, the total number of activity days for a given activity has been estimated for a particular destination (Box 9).

Once the population is known, multiplying the first equation by population determines total number of participants in that activity for day trips and overnight trips. Multiplying that quantity by the output of the second equation determines the total number of activity trips for that activity and type of trip. The third equation takes the total number of activity trips and distributes them among the various destinations. Finally, the last equation predicts the number of days of participation for each activity on overnight trips.

In summary, using all the equations, the model can predict the total number of activity days from a given origin to any number of destinations for day trips and overnight trips. Taken individually, recreational planners can use any of the equations to predict a given component of total participation; either the probability of participation, frequency, spatial allocation or duration.

The equations of the model were estimated using various regression techniques using two types of data; primary survey data which contains socio-demographic data and trip specific data obtained via a telephone survey conducted by ABT Associates in 1977 and secondary data describing characteristics of each subregion and the supply information for each activity.[10] The primary data obtained via ABT Associates' Summer Activities Survey provided the key participants and non-participants for each activity. The survey was conducted during the September of 1977 using a multi-stage stratified random sample of individuals 12 years or older, living in the New England-New York region. The entire region was stratified into 15 geographic subregions -- corresponding to the subregional breakdown used to determine the spatial allocation of participation--and separate samples were drawn from each stratum. In total there were 1541 completed interviews, or approximately 100 interviews from each subregion.

Information regarding the aggregate characteristics of each subregion and supply data relevant for individual activities was obtained from the Commonwealth of Massachusetts. Unfortunately, the secondary data proved to be far less consistent or reliable than the primary data and therefore its usefulness was limited.[11] It was originally felt that such supply information would be valuable determinants of participation, especially when accounting for differences in participation among the various subregions. Thus, these secondary data were originally intended to be used as independent variables in each of the forecasting equations. However, due to data inconsistencies and a great deal of missing information, an alternative formulation was developed whereby a separate supply model was developed and linked to the main forecasting model.[12]

---

[9] The spatial allocation portion of the model is a relatively complex algorithm which projects the distribution of participation on the basis of the probability of traveling a given distance from an origin of known characteristics to a destination of known characteristics. The basis for these estimates is a multi-nomial logit model which was used to project the probability of traveling certain distances for each activity by day and overnight trip, based on the characteristics of the individual origin and destination. For a more detailed description see Volumes 2 and 5 of ABT's report, Analysis and Computer Modeling of Summer Outdoor Recreation Activities in the Northeast and Documentation for the Summer Outdoor Recreation Forecasting Model respectively.

[10] Supply data refers to physical characteristics associated with each subregion that is necessary for participation in the various activities. Thus, number of ocean beaches would be a supply variable for Swimming in Salt Water while number of 18 hole golf courses in a subregion would be a supply variable for Golfing.

[11] The problems with the supply data were lack of consistent definition or method of collection across subregions and, most importantly, too many missing observations. In fact, there were a sufficient number of missing observations that it was not possible to use the supply data directly in the model.

The dependent variables in each equation were taken from the primary data collected by ABT Associates. For the first equation, the probability of participation, respondents were categorized into two groups for each activity, and for overnight and day trips, and the dependent variable was whether or not they were in the group participating in that particular activity. For the second equation the number of different instances of participation of those respondents who participated in a given activity, separately for overnight and day trips, was used as the dependent variable. For the spatial allocation component of the model the probability of traveling a specified distance for a given activity was estimated and used as part of a more complex spatial allocation algorithm. Finally, for the fourth equation, which was estimated only for overnight trips, the number of different activity days of participation on a given trip over all activities was used as the dependent variable.

Most of the key independent variables of each equation were general socio-demographic information and specific activity trip information.[13] For the most part both types of data were obtained from the ABT Summer Activities Survey. In using the model to make predictions the user must only estimate values for the independent variables that are expected to change over time, input them into the model, and assuming that a number of other underlying relationships will be maintained over time, the model will predict the various components of recreation discussed above.

Finally, it should be noted that the entire model has been installed as a self-contained, user operated computer model. The computer model has built into it a great number of adjustments that must be made before the output of the individual equations can be used to obtain the desired projections.[14] In addition, the computer model restricts many of the independent variables, primarily the trip specific variables, to default values otained from ABT's Summer Survey. For other variables, unless the user specifies changes, the computer will default to average values used in estimating the model. The user need only specify changes in certain independent variables and the model will print out projections of participation by activity for each subregion in the New England-New York region. An example of the output of the model for one activity and one subregion are presented in Exhibit 2. If total participation for any activity within the region is required then it is a simple matter of aggregating the distribution of participation from each origin.

FORECAST RESULTS

This section presents results of implementing the model to forecast the expected number of activity days to be spent in each subregion in 1985 for two activities--Swimming in Salt Water and Hiking and Wilderness Camping. For this example, 1985 values for population, age, and income were used in the model. All other variables were assumed to remain constant at their 1977 levels.

PROJECTIONS OF EXOGENOUS VARIABLES

Table 1 presents the values of population, age, and income for 1977 and 1985 for each of the 15 subregions. The 1977 population estimates were provided by the states, themselves. The 1977 age and income estimates are the sample means of the ABT survey data. Subregional projections of population, age and income were derived using state estimates published by the National Planning Association (NPA).[15]

The subregional population estimates

---

[12] For each activity a proxy for the subregional supply characteristics was created based on the survey data. That proxy, which was an index relating activity participation within a subregion to the whole region, was then used as an independent variable in the forecasting model. In addition, a separate supply model was developed which related the actual supply variables to the proxy supply variables. Within the supply model changes in actual supply variables could be used to change the proxy values which would then be changed in the main forecasting model. This indirect technique allows inclusion of supply variables in the forecasting model without the problems of the actual supply variables. Thus, a recreation planner can still determine the effect of changes in a supply variable, for example of golf courses, on participation.

[13] Examples of the independent variables used to estimate the equations are age, income, sex, race, distance travelled, number of people on a trip and other respondent and participant characteristics.

[14] Many of the adjustments convert values in logarithms and back again, make adjustments that were necessary to calibrate the model and in general ease the process of inputing variables into the model.

[15] Scara, Timothy B., David W. Fay, and Joe Won Lee, State and Metropolitan Growth Patterns, 1960-1990, Washington: National Planning Association, Report Number 77-R-1, 1977.

EXHIBIT 2

```
                                          ACTIVITY = HIKING
                                          ORIGIN= W CONN
                                    POPULATION=     1758.00 (THOUSANDS)
                                ALL_ACTIVITY_DAYS_ARE_REPORTED_IN_THOUSANDS

                 DAY TRIPS                                                   OVERNIGHT TRIPS
     PROBABILITY OF PARTICIPATION------->     0.0493                    PROBABILITY OF PARTICIPATION------->     0.0697
         MULTIPLIED BY                                                      MULTIPLIED BY
     FREQUENCY OF PARTICIPATION----->  10.76364                         FREQUENCY OF PARTICIPATION----->   2.93648
               EQUALS TOTAL # OF DAY TRIPS----->     932.97                       EQUALS TOTAL # OF OVERNIGHT TRIPS----->     359.91
                             PROBABILITY OF MAKING DAY TRIPS TO THE FOLLOWING DESTINATIONS:

W_CONN_ E_CONN_ W_MAINE E_MAINE MA-CAPE EAST_MA WEST_MA NO_NH__ SO_NH__ SO_NY__ MID_NY_ NO_NY__ R_I____ NO_VT__ SO_VT__
0.74962 0.20979 0.0     0.0     0.00195 0.00468 0.00092 0.0     0.00195 0.0     0.00029 0.0     0.0     0.0     0.0
MULTIPLIED BY THE TOTAL # OF DAY TRIPS MINUS    28.7 ACTIVITY DAYS OUTSIDE THE NY/NEW ENGLAND AREA EQUALS DAY TRIP ACTIVITY DAYS TO

W_CONN_ E_CONN_ W_MAINE E_MAINE MA-CAPE EAST_MA WEST_MA NO_NH__ SO_NH__ SO_NY__ MID_NY_ NO_NY__ R_I____ NO_VT__ SO_VT__
  699.4   195.7     0.0     0.0     1.8     4.4     0.9     0.0     1.8     0.0     0.3     0.0     0.0     0.0     0.0
                             PROBABILITY OF MAKING OVERNIGHT TRIPS TO THE FOLLOWING DESTINATIONS:

W_CONN_ E_CONN_ W_MAINE E_MAINE MA-CAPE EAST_MA WEST_MA NO_NH__ SO_NH__ SO_NY__ MID_NY_ NO_NY__ R_I____ NO_VT__ SO_VT__
0.18210 0.06030 0.02686 0.01794 0.02989 0.14747 0.05916 0.02888 0.02781 0.07070 0.03454 0.01810 0.03208 0.01818 0.02729
DURATION OF PARTICIPATION IN ACTIVITY ON OVERNIGHT TRIPS IS      2.95 DAYS, MULTIPLIED BY THE ABOVE PROBABILITIES MINUS   232.4
 ACTIVITY DAYS OUTSIDE THE NY/NEW ENGLAND AREA, GIVES THE NUMBER OF OVERNIGHT TRIP ACTIVITY DAYS AT DESTINATION :

W_CONN_ E_CONN_ W_MAINE E_MAINE MA-CAPE EAST_MA WEST_MA NO_NH__ SO_NH__ SO_NY__ MID_NY_ NO_NY__ R_I____ NO_VT__ SO_VT__
  193.5    64.1    28.6    19.1    31.8   156.7    62.9    30.7    29.6    75.1    36.7    19.2    34.1    19.3    29.0
                        ADDING DAY TRIP ACTIVITY DAYS  TO OVERNIGHT ACTIVITY DAYS GIVES THE TOTAL ACTIVITY DAYS AT :

W_CONN_ E_CONN_ W_MAINE E_MAINE MA-CAPE EAST_MA WEST_MA NO_NH__ SO_NH__ SO_NY__ MID_NY_ NO_NY__ R_I____ NO_VT__ SO_VT__
  892.9   259.8    28.6    19.1    33.6   161.1    63.7    30.7    31.4    75.1    37.0    19.2    34.1    19.3    29.0
```

TABLE 1. VALUES OF EXOGENOUS VARIABLES - 1977 AND 1985

SUBREGION	POPULATION (in thousands)		MEAN AGE OF POPULATION 12 years and over		MEAN INCOME OF THE POPULATION (in thousands of 1977 dollars)	
	1977	1985	1977	1985	1977	1985
WEST CONNECTICUT	1758.0	1802.0	39.4	39.5	17.391	19.974
EAST CONNECTICUT	1405.0	1440.0	41.8	41.9	15.000	17.430
WEST MAINE	698.0	802.0	43.7	41.8	10.999	12.853
EAST MAINE	300.0	346.0	40.8	39.0	11.627	13.679
CAPE MASSACHUSETTS	990.0	1059.0	41.2	41.1	13.211	15.752
EAST MASSACHUSETTS	3324.0	3555.0	41.6	41.5	16.347	18.750
WEST MASSACHUSETTS	1350.0	1444.0	41.2	41.1	13.327	15.595
NORTH NEW HAMPSHIRE	285.0	321.0	46.3	41.7	12.884	15.128
SOUTH NEW HAMPSHIRE	573.0	646.0	42.6	38.3	14.725	17.266
SOUTH NEW YORK	10447.0	10688.0	40.9	41.9	16.281	18.891
MID NEW YORK	4210.0	4307.0	37.9	38.8	16.947	19.275
NORTH NEW YORK	425.0	435.0	38.9	39.8	13.700	15.833
RHODE ISLAND	1016.0	931.3	40.9	41.0	13.972	16.372
NORTH VERMONT	175.0	182.0	38.9	36.8	13.419	15.930
SOUTH VERMONT	313.0	326.0	43.8	41.4	12.388	14.659

were calculated from the state values assuming that changes at the subregional level were proportional to those at the state level. That is, the distribution of population among subgroups within a given state loss held constant, at its 1977 value.

The NPA report does not publish the mean age of the population, per se. However, the report does include a breakdown of population by age cohort groups for each state. The mean age of the population 12 years old and over of each state was estimated by taking a population weighted average of the cohort groups, 12 years of age and over. Subregional estimates were then calculated assuming that the change for each subregion was proportional to that of its encompassing state.

Mean population income was derived assuming a constant rate of growth among subregions within a state over the 1977-1985 period. The growth rates were calculated based on the NPA's estimates of state per capita income for 1977 and 1985.[16]

FORECASTS OF RECREATION PARTICIPATION

The 1985 projections of population, age, and income were used in the model to derive forecasts of the number of activity days for Swimming in Salt Water and Hiking and Wilderness Camping at each destination in 1985. These forecasts, as well as the corresponding estimates for the baseline year-1977, are presented in Tables 2 and 3 for Swimming in Salt Water and Hiking and Wilderness Camping, respectively. For simplicity, the tables show only the number of activity days resulting from both day trips and overnight trips. Note that these estimates represent the total number of activity days to be expected at each destination by recreation participants originating in the Northeast region.

The forecasts for Swimming in Salt Water (Table 2) suggest that every subregion, except East Connecticut, will experience an increase in the number of activity days spent at that destination. The two subregions in Maine show the largest percentage increases, while Cape Cod in Massachusetts and South New York exhibit the largest absolute changes.

In general, increases in day trips contribute slightly more to increases in the total number of activity days than do changes in overnight trip activity days. In East Connecticut, where visitation is expected to fall (or remain relatively constant at its 1977 level),[17] day trips are estimated to

---

[16] The actual 1985 income estimates (in thousands of 1977 dollars) were about 5% greater than those shown in Table A. Values used in the model are constrained to ± 3 standard deviations of the mean. The figures in Table A reflect the upper bound of this constraint and were the values used in deriving the projections.

[17] Given the accuracy of this (or any) forecasting model, a change of 0.5% can not be considered significant.

TABLE 2

FORECAST OF ACTIVITY DAYS FOR SWIMMING IN SALT WATER, 1977 AND 1985 IN THOUSANDS

SUBREGION OF DESTINATION	1977		1985		CHANGE IN TOTAL ACTIVITY DAYS (1985 MINUS 1977)	
	DAY TRIP ACTIVITY DAYS	TOTAL ACTIVITY DAYS	DAY TRIP ACTIVITY DAYS	TOTAL ACTIVITY DAYS	ABSOLUTE	PERCENT*
WEST CONNECTICUT	11,471	22,193	11,655	22,951	758	3.4
EAST CONNECTICUT	11,907	16,491	11,551	16,407	-83	-0.5
WEST MAINE	3,142	9,816	3,643	10,764	948	9.7
EAST MAINE	58	3,195	81	3,427	268	8.4
CAPE MASSACHUSETTS	12,218	16,531	13,137	17,724	1,193	7.2
EAST MASSACHUSETTS	12,465	17,176	13,076	18,082	906	5.3
WEST MASSACHUSETTS	-0-	-0-	-0-	-0-	-	-
NORTH NEW HAMPSHIRE	-0-	-0-	-0-	-0-	-	-
SOUTH NEW HAMPSHIRE	4,713	8,805	5,101	9,478	673	7.6
SOUTH NEW YORK	62,379	69,083	64,206	71,999	2,916	4.2
MID NEW YORK	-0-	-0-	-0-	-0-	-	-
NORTH NEW YORK	-0-	-0-	-0-	-0-	-	-
RHODE ISLAND	10,979	17,342	11,147	17,869	527	3.0
NORTH VERMONT	-0-	-0-	-0-	-0-	-	-
SOUTH VERMONT	-0-	-0-	-0-	-0-	-	-

* Percent Change = (1985 data minus 1977 data/1977 data)

TABLE 3

FORECAST OF ACTIVITY DAYS FOR HIKING AND WILDERNESS CAMPING 1977 AND 1985 IN THOUSANDS

SUBREGION OF DESTINATION	1977		1985		CHANGE IN TOTAL ACTIVITY DAYS (1985 MINUS 1977)	
	DAY TRIP ACTIVITY DAYS	TOTAL ACTIVITY DAYS	DAY TRIP ACTIVITY DAYS	TOTAL ACTIVITY DAYS	ABSOLUTE	PERCENT*
WEST CONNECTICUT	968	3,406	851	3,348	-58	-1.7
EAST CONNECTICUT	679	1,225	666	1,226	1	0.1
WEST MAINE	358	1,514	399	1,637	123	8.1
EAST MAINE	137	636	147	675	39	6.1
CAPE MASSACHUSETTS	317	1,239	303	1,260	21	1.7
EAST MASSACHUSETTS	1,151	2,210	1,095	2,209	-1	-0.05
WEST MASSACHUSETTS	326	836	309	830	-6	-0.7
NORTH NEW HAMPSHIRE	776	1,819	844	1,936	117	6.4
SOUTH NEW HAMPSHIRE	870	1,790	905	1,879	89	5.0
SOUTH NEW YORK	197	1,471	34	1,307	-164	-11.1
MID NEW YORK	1,423	3,750	1,292	3,615	-135	-3.6
NORTH NEW YORK	503	912	476	893	-19	-2.1
RHODE ISLAND	233	1,226	213	1,240	14	1.1
NORTH VERMONT	179	521	180	533	12	2.3
SOUTH VERMONT	705	1,888	710	1,928	40	2.1

*Percent Change = (1985 data minus 1977 data/1977 data).

decline by 356 thousand in 1985; this decrease is partially offset by an increase in the number of overnight trip activity days.

The forecasts for Hiking and Wilderness Camping (Table 3) exhibit much smaller changes from the 1977 baseline than did swimming in Salt Water. Moreover, 6 of the 15 subregions are expected to experience a decline in visitation for Hiking and Wilderness Camping, although in several cases the decrease is too small to be considered significant.

The projections suggest that New York will be the greatest loser of activity days while Maine, New Hampshire and Vermont will be the largest gainers.

The 1985 forecasts suggest that day trips to 9 of the subregions will fall relative to their 1977 level. In three of these subregions--East Connecticut, Cape Massachusetts, and Rhode Island-- the increase in overnight trip activity days more than offsets the decline in day trips, resulting in increases in total activity days.

The differences in the magnitude and direction of the changes between the two activities stem from several sources. First, since population at each origin drives the model, increasing population and holding all variables constant at their 1977 values would result in an overall increase in the total number of activity days for both Swimming in Salt Water and Hiking and Wilderness Camping. However, when age and income are allowed to vary, the overall effect depends upon the signs and magnitude of their coefficients in the various regression equations.[18] Since the relative effects of age and income as measured by the regression coefficients are different for the two activities, changing these variables produce different results.

Secondly, participation in Swimming in Salt Water is very much constrained by natural resources. Only 9 of the 15 subregions have coastal area, limiting the number of possible destinations.

Other Uses of the Forecasting Model

The data generated by the forecasting model are amenable to other kinds of analysis as well. In particular, the model's forecasts can be analyzed in terms of recreationists' travel patterns among the sub-state regions to engage in various kinds of outdoor recreation. For a given activity, the model estimates the number of day trips which originate within each subregion, and also estimates the subregion in which the activity actually takes place, that is, the destination.[19]

For most outdoor recreation activities, some residents will remain in their own subregion to participate in the particular activity while other residents will travel to a different subregion. If a greater number of people leave a subregion than enter the subregion to engage in an activity, then that subregion is experiencing a net outflow of participants to other subregions. If more people come into the subregion than leave it, then that subregion is importing participants, that is, there is an inflow of participants for that recreation activity.

Discussion of Day Trip Recreation

Table 4 presents the net inflows and outflows for day trips to participate in Swimming in Salt Water during the summer of 1977. For each of the 15 subregions, the number of day trips (for Swimming in Salt Water) which originated in the subregion is subtracted from the total number of day trips which had that subregion as its destination.

As is noted on the left hand column, residents of West Connecticut took an estimated 11,599,000 day trips to go Swimming in Salt Water during the summer of 1977 (i.e., these day trips originated from this sub-region). Of all the Salt Water Swimming day trips in the New England-New York region, West Connecticut was the final destination for 11,471,000 of these trips. Thus, while most West Connecticut residents remained within their own subregion to participate in this activity, there was a net outflow of 128,000 day trips to places outside of West Connecticut because more people exited from this subregion than entered it from the other 14 subregions. In strong contrast is East Connecticut which experienced a substantial inflow into its subregion for Salt Water Swimming day trips from other parts of the New England-New York region.

For some subregions, of course, there can be no inflow of recreationers to engage in Salt Water Swimming simply because the subregion lacks this natural resource. Thus, subregions such as West Massachusetts, North

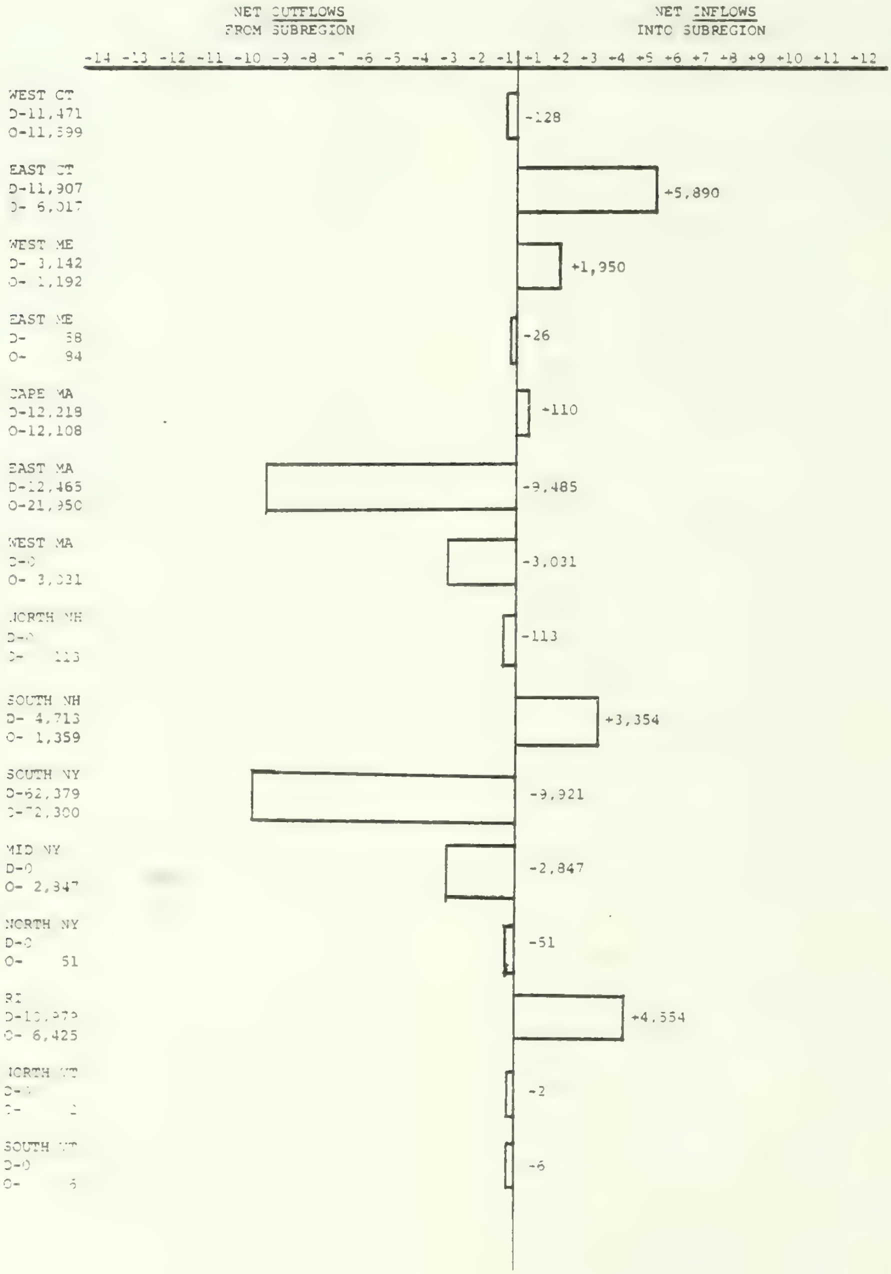
---

[18] A detailed discussion of the equations is presented in Volume 2 of ABT's report, Analysis and Computer Modeling of Summer Outdoor Recreation Activities in the Northeast.

[19] Note that the model's estimates of recreation activity at each destination is based on travel from within the New England-New York region only. The model does not provide estimates of recreationists who enter the region from Canada, other parts of the U.S., etc.

TABLE 4

1977 DAY TRIPS (IN 000) FOR SALT WATER SWIMMING



and South Vermont, can only experience outflows to the subregions which have ocean beaches.

Overall, East Connecticut, West Maine, South New Hampshire, and Rhode Island enjoy substantial inflows of recreationers for Salt Water Swimming day trips. Interestingly, both East Massachusetts and South New York experience considerable outflows of day trips for Swimming in Salt Water, even though both these subregions have ocean beaches.

Table 5 presents model projections of day trip activity for Swimming in Salt Water for the year 1985,[20] based upon expected changes in the population, age, and income in the New England-New York region.[21] The data suggest that the subregions will likely continue to exhibit the same basic patterns of either importing or exporting day trip Salt Water Swimming participants for 1985 as they did in 1977, although the size of the inflows and outflows have changed. East Connecticut and Rhode Island are each likely to experience approximately 500,000 more day trips for this beach activity in 1985 as compared to the inflows into these subregions during 1977. Also, the outflow of day trip participants from South New York is likely to be considerably less in 1985; while only slightly more day trips will originate in this subregion, substantially more participants (than in 1977) will be destinating in South New York for Salt Water Swimming day trips.

A similar analysis is presented for day trips to engage in Hiking and Wilderness Camping during 1977. Table 6, which displays the net inflows and outflows for each of the 15 subregions, demonstrates very different patterns than was observed for Swimming in Salt Water. Immediately obvious is the fact that people take far fewer day trips to engage in this activity. East Massachusetts enjoys the largest inflow of day trip participants for Hiking and Wilderness Camping (in strong contrast to its substantial outflows of day trip participants for Swimming in Salt Water). Also noteworthy is the fact that although more day trips for Hiking and Wilderness Camping originate in the Mid New York subregion, it still experiences a strong outflow of such day trips.

Table 7 presents the forecasting model's estimates for 1985 day trips for Hiking and Wilderness Camping. Again, the basic patterns remain although there are slight changes in the magnitude of the inflows/outflows.

Discussion of Total Activity Days

Tables 8 and 9 display the net inflows and outflows in 1977 and 1985 for the total activity days in which people go Swimming in Salt Water. West Connecticut, which exhibited a slight outflow of day trips (see Table 4), now experiences as significant inflow of total activity days; the reversal in flows is accounted for by the fact that this subregion is a popular destination for overnight trips where recreationists participate in Salt Water Swimming. The other coastal subregions also enjoy substantial inflows of participants, with the notable exception of East Massachusetts and South New York which continue to export participants to other areas. A comparison of 1977 and 1985 forecasts (in Tables 8 and 9 respectively) indicate that the same basic patterns will obtain throughout this time period.

Forecasts of the total activity days for Hiking and Wilderness Camping in each subregion for 1977 and 1985 are presented in Tables 10 and 11. West Connecticut, North New Hampshire, and South Vermont have the largest number of total activity days destinating in the subregion (3,750,000 activity days); but considerably more activity days are originating from this part of the state (8,537,000), and thus this subregion experiences a significant outflow of participants.

The data for 1977 in Table 12 focuses on Mid New York and displays the net inflows into the other subregions for Hiking and Wilderness Camping activity days from Mid New York. While other parts of the state are getting some inflow from Mid New York, other subregions--West Connecticut and East Massachusetts, in particular--are the greatest gainers of the Hiking and Wilderness Camping activity days which are outflowing from Mid New York.

CONCLUSIONS

There is considerable travel from one substate region to other subregions in the New England-New York area to participate in various outdoor recreation activities. The total number of activity days originating and destinating in each subregion demonstrate significant flows of recreationists throughout the entire region; this is also true, though to a lesser degree, when day trip activity is analyzed.

Model projections of recreation activity in 1985--based on estimated changes in the average age, income, and population of each subregion--suggest that some changes in magnitude, but not of direction of the subregional inflows and outflows, of recreation activities will occur.

---

[20] Data based on NPA estimates.

[21] As with all forecasting models, the output should not be considered as absolute predictions, but is best utilized by analyzing the relative changes which are estimated under varying assumptions.

TABLE 5

1985 DAY TRIPS (IN 000) FOR SALT WATER SWIMMING

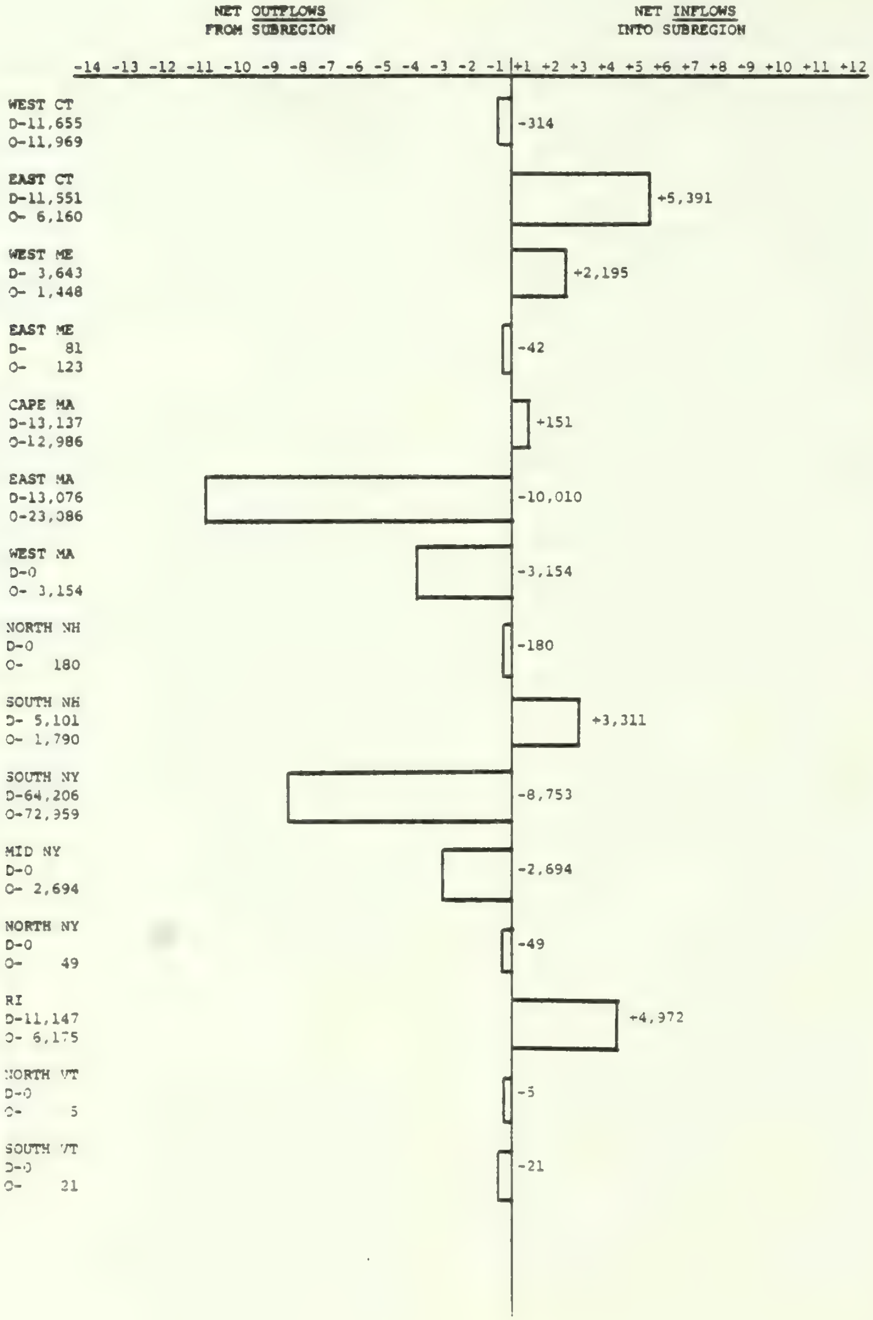


TABLE 6

1977 DAY TRIPS (IN 000) FOR HIKING & WILDERNESS CAMPING

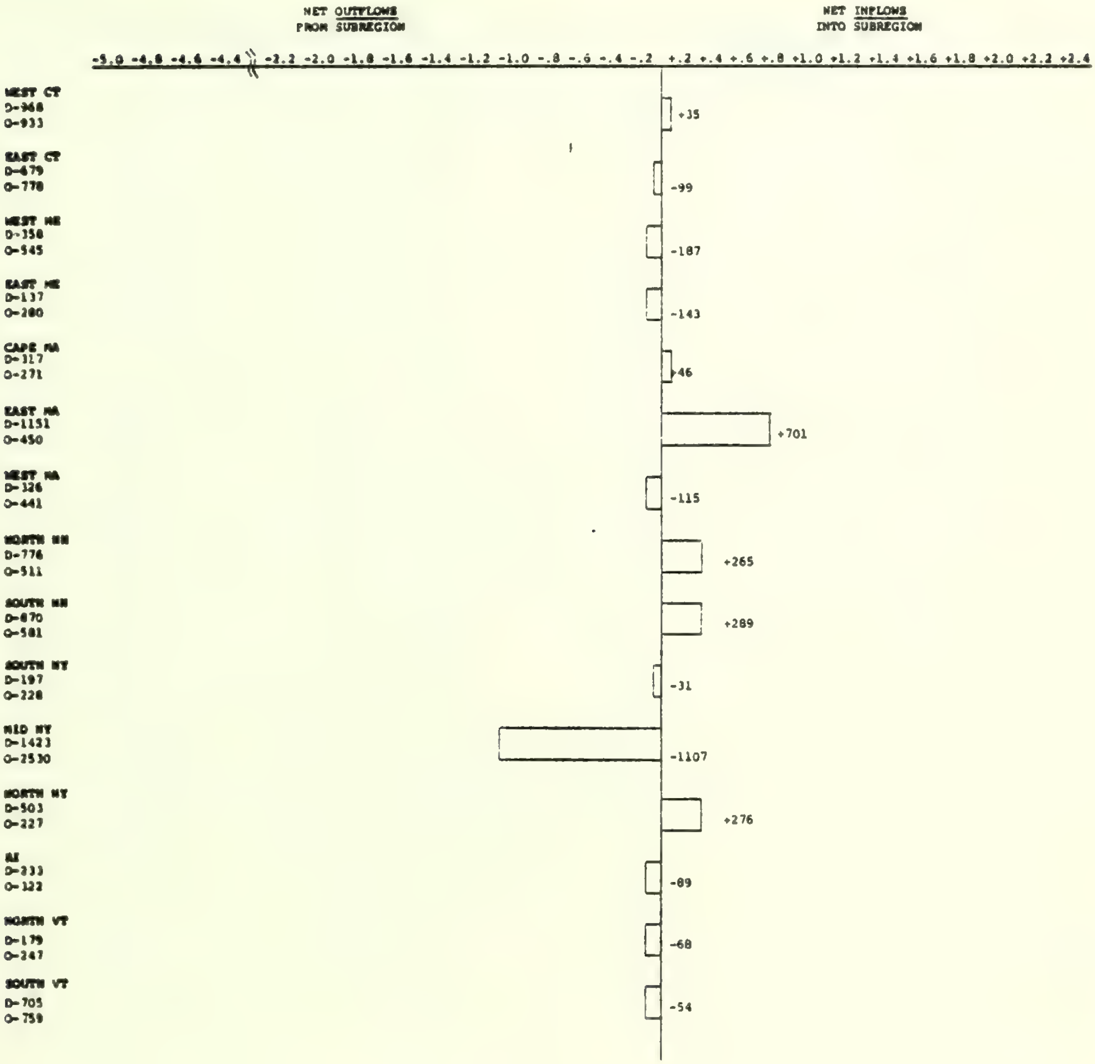


TABLE 7

1985 DAY TRIPS (IN 000) FOR HIKING & WILDERNESS CAMPING

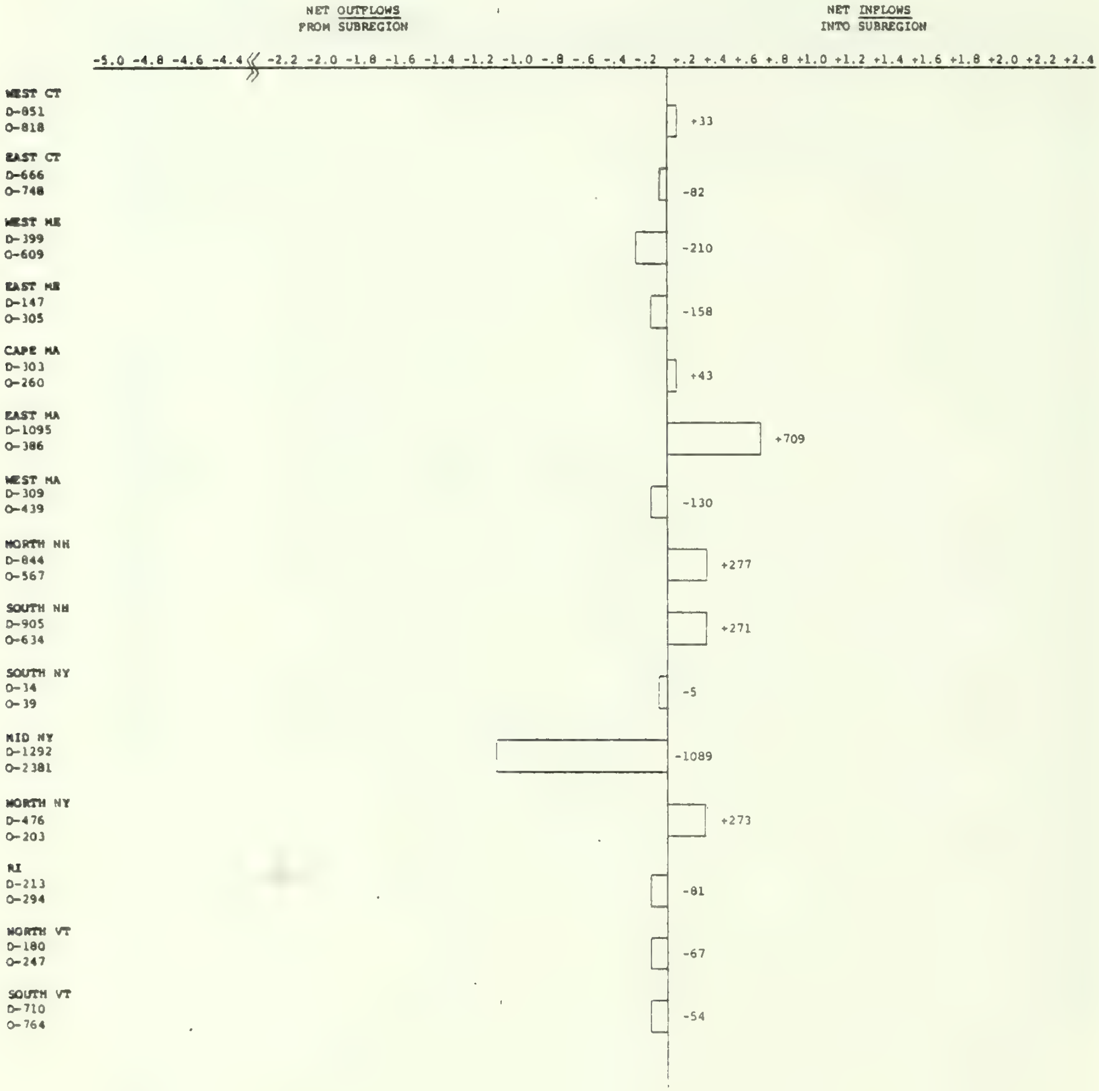


TABLE 8

1977 TOTAL ACTIVITY DAYS (IN 000) FOR SALT WATER SWIMMING

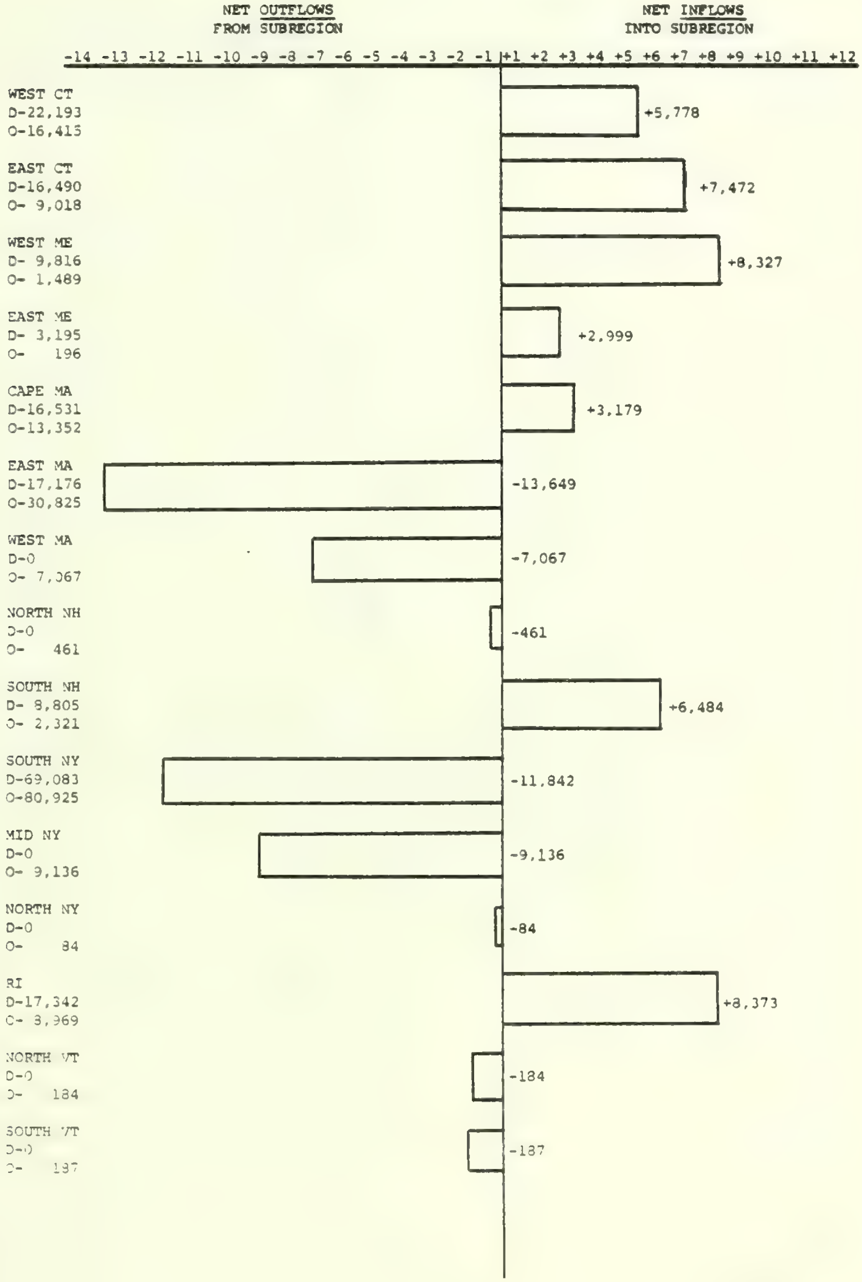


TABLE 9

1985 TOTAL ACTIVITY DAYS (IN 000) FOR SALT WATER SWIMMING

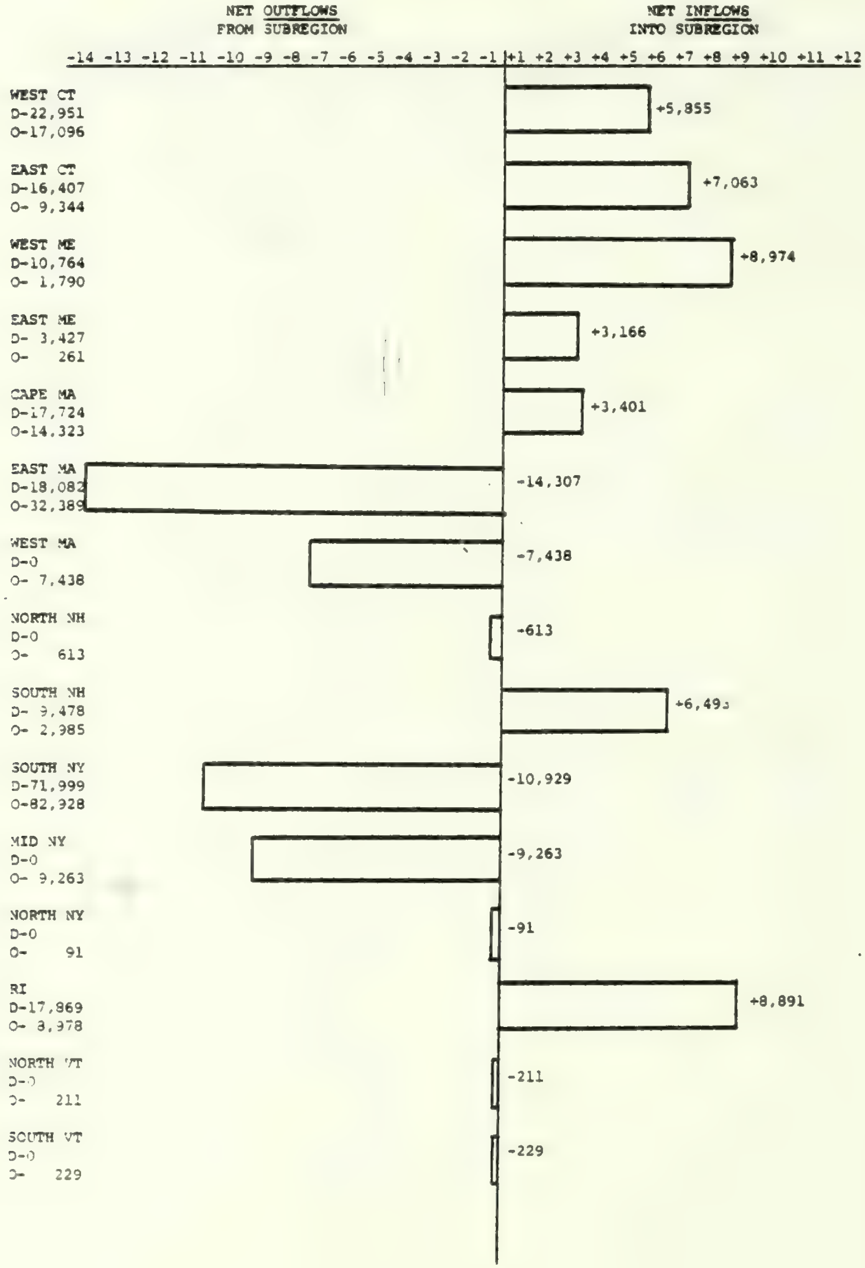


TABLE 10

1977 TOTAL ACTIVITY DAYS (IN 000) FOR HIKING & WILDERNESS CAMPING

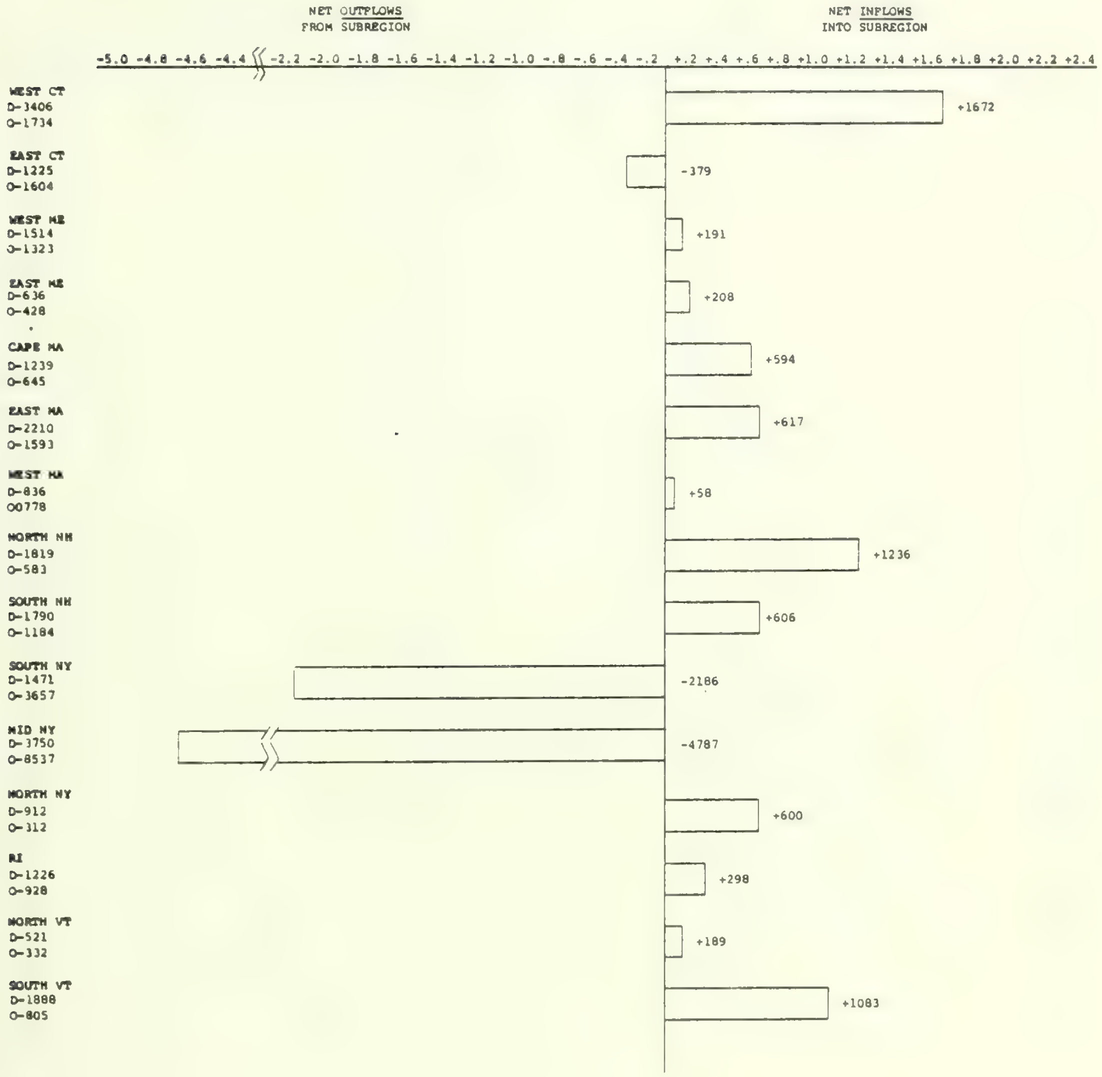


TABLE 11

1985 TOTAL ACTIVITY DAYS (IN 000) FOR HIKING & WILDERNESS CAMPING

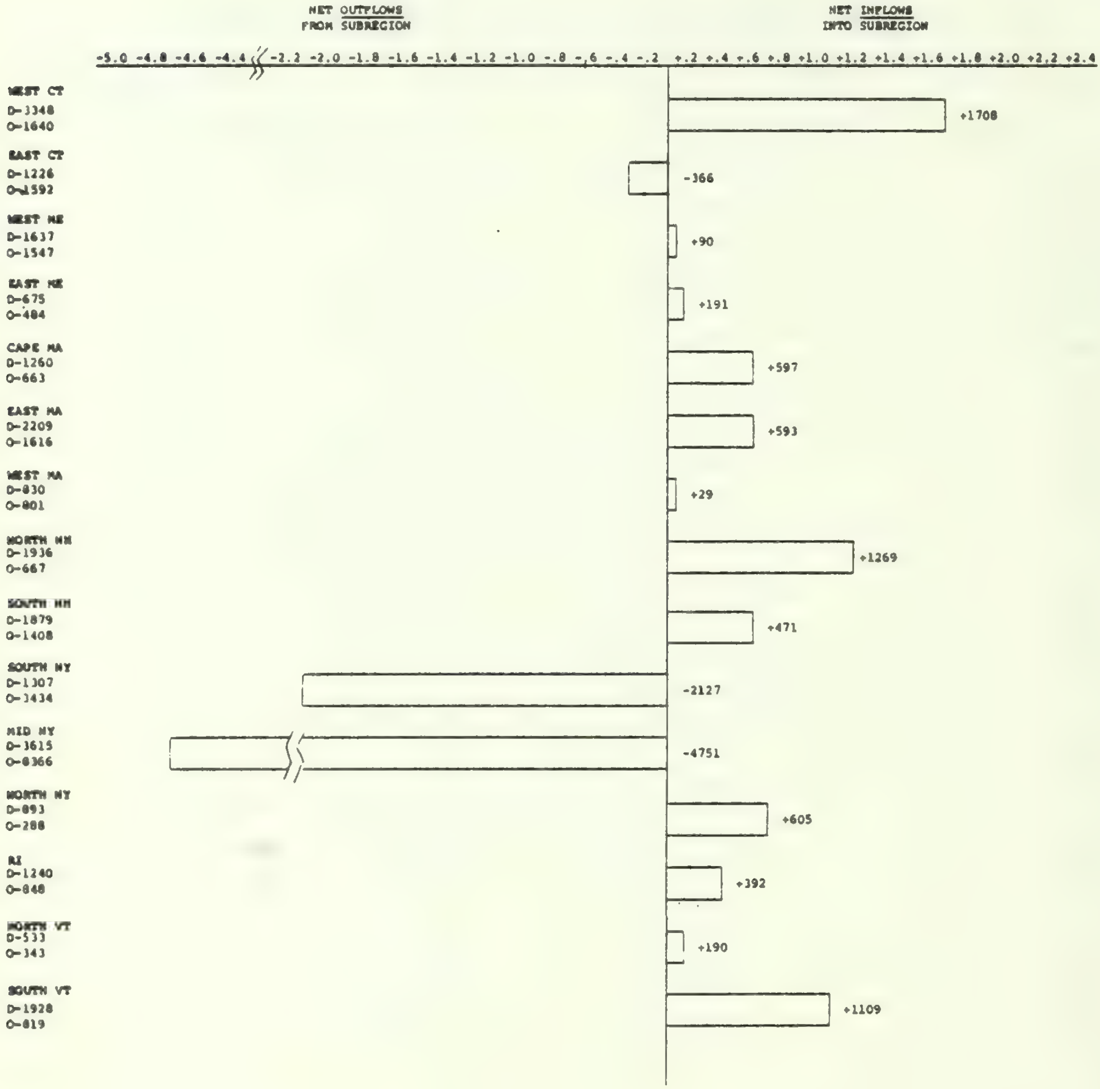
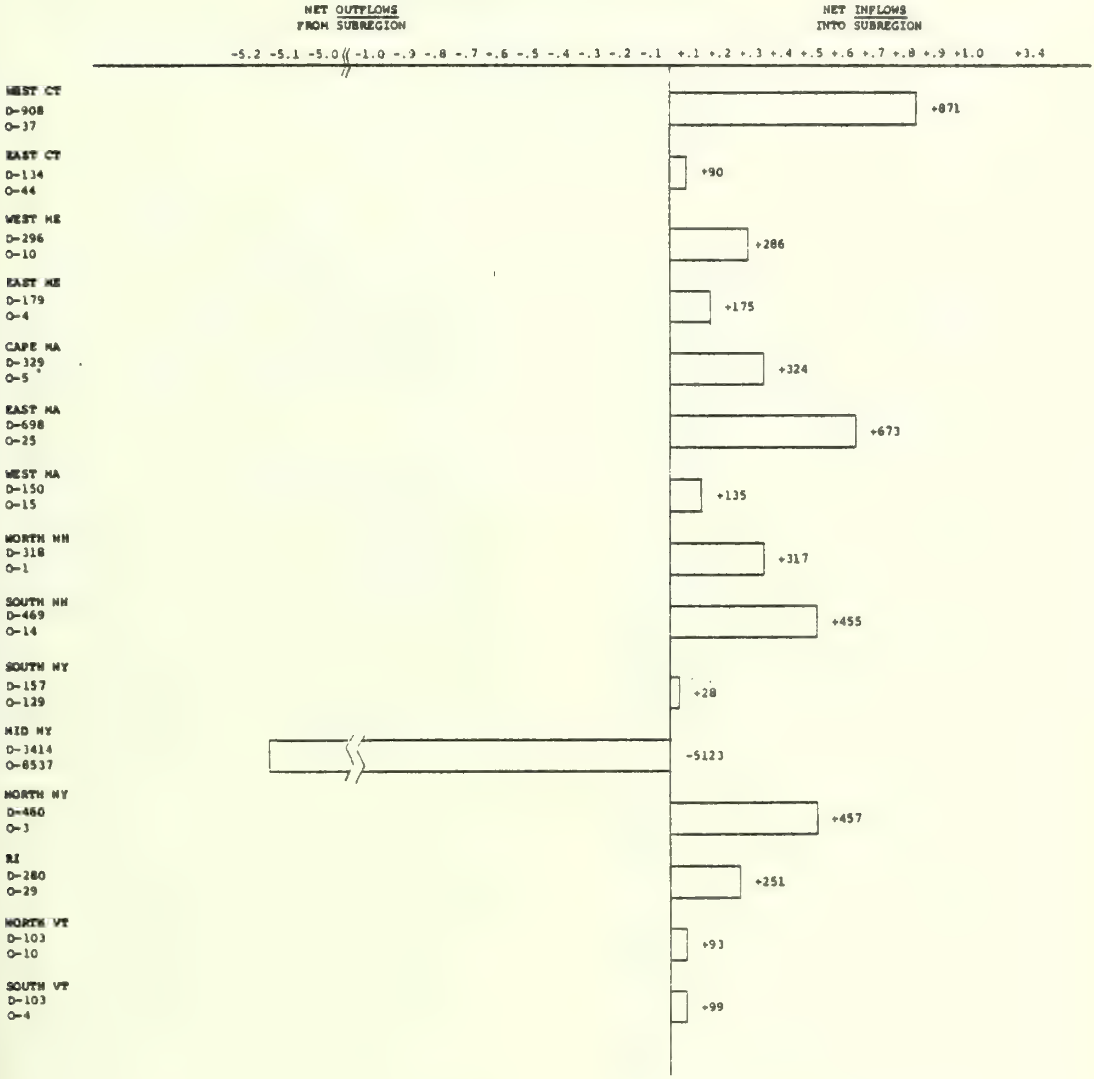


TABLE 12

NET INFLOWS IN OTHER SUBREGIONS FROM MID NEW YORK

(1977 TOTAL ACTIVITY DAYS -IN 000- FOR HIKING & WILDERNESS CAMPING)



A SIMULATION MODEL FOR FORECASTING DOWNHILL SKI PARTICIPATION[1]

Daniel J. Stynes
Department of Park and Recreation Resources
Michigan State University
East Lansing, MI

Daniel M. Spotts
Department of Park and Recreation Resources
Michigan State University
East Lansing, MI

INTRODUCTION

The purpose of this paper is to describe rogress in the development of a general comuter simulation model to forecast future evels of outdoor recreation participation. he model is applied and tested for downhill kiing in Michigan.

The approach combines a cohort-survival opulation model with a simple recursive odel of skier adoption and dropout decisions. t has been implemented for computer simulaion in FORTRAN. Simulations of numbers of kiers (both active and inactive) and their haracteristics (age, length of involvement) an be generated for any year between 1950 nd 2000. By altering model inputs the user ay generate a variety of future scenarios nd test various downhill ski promotion and evelopment strategies.

THE APPROACH - COMPUTER SIMULATION

A number of distinct forecasting models ave been applied to the prediction of outoor recreation participation. These are eviewed in Moeller and Echelberger (1974) d Stynes, Bevins, and Brown (1980). Two ep linear regression models and simple end extension methods predominate. Difsion models (West 1977, Stynes and codronski 1980) and Delphi studies (Moeller al. 1977) have also been used to predict ture participation and characteristics of tdoor recreation activity.

Perhaps the most serious problem with mple analytic forecasting models is their ilure to incorporate the time dimension in meaningful way. The models are mostly static, or at best comparative static. Many are based upon cross-sectional data and do not include dynamic structural features or processes. The models do not therefore work well in a dynamic environment and they generally fail to shed much light upon the processes which underlie trends in outdoor recreation participation.

We argue here that recreation systems are quite dynamic, characterized by timelags, feedback effects, and interactions between variables over time. Understanding of these dynamic processes could yield significant improvements in our ability to forecast the behavior of recreation systems. Simulation models are more suited to the exploration and modeling of such processes.

The Limits to Growth models (Meadows 1972) are perhaps the most widely known applications of computer simulation to futures research. Within recreation, computer simulation models have been applied to planning and management. The Wilderness Travel Simulator (Shechter and Lucas 1978, Smith and Krutilla 1976) and recreation trip distribution models (Cesario 1975, Ellis and Van Doren 1967) are good examples. Ladany (1975) includes a number of simulation models in his collection, Management Science Applications to Leisure Time Operations. More widespread application of these techniques, including forecasting applications, have been constrained by a lack of suitable data bases, lack of needed simulation and modeling skills within recreation, and limited progress in quantification of relationships describing outdoor recreation behavior patterns.

Computer simulation models have several advantages over analytic approaches:

1. They are more realistic, more easily

---

[1] Paper presented at the National Outdoor creation Trends Symposium, Durham, NH, April -23, 1980.

understood, and more persuasive.

2. They are more flexible - no standard assumptions, easily modified, and lend themselves to a component approach.

3. They treat time in a meaningful way.

4. They permit a wide range of experiments on the model.

5. They "facilitate understanding of complicated systems of relationships relevant to policymaking". (Hamilton 1969)

6. They contribute to theory development, guide research, and pinpoint data collection priorities.

There are, of course, corresponding disadvantages. Model development can be expensive and complex, simulation models often have extensive and unique data requirements, and model validation is not straightforward.

In this case, the lack of good time series data on skiing ruled out a trend extension model. Existing data was scattered, of inconsistent quality, and very limited except for the two years 1968 and 1978. Even this data was not well-suited to estimating the numbers of skiers or the volume of skiing activity in Michigan. Hypothesized errors in the data bases did not recommend a purely "statistical" approach. Limitations in the data would have to be compensated for by a model which captured important structural features of downhill ski participation decisions.

Given the state of knowledge about the ski market and uncertainty about the future, our purpose became one of not so much to forecast the future, but to create a better understanding of the forces likely to affect the future of downhill skiing in Michigan and to permit the testing of alternative actions. The simulation model is designed to be a tool that ski area managers, planners, and marketing personnel might use to better understand the future and to assist in decision making.

A model was desired that could be adapted, extended, and refined as our understanding of the ski market increases and as the variables influencing skier decisions change over time. A secondary purpose of the model is to guide future research and data collection. The potential long-term benefits of a computer simulation model strongly recommended this approach.

MODEL SUMMARY

The forecasting model combines a cohort-survival population model with a similar model of skier adoption, dropout, and reado tion decisions. The population component o the model updates the age structure of the population each year based upon estimates o fertility and mortality.

The skier component of the model determines the numbers of persons of each age th are (1) active skiers, (2) inactive skiers, and (3) non-skiers. Active and inactive skiers are further divided by years of experience in downhill skiing. The model is recursive. Rates of adoption, dropout, and readoption are applied to populations in ye N to determine the numbers of active skiers inactive skiers, and non-skiers in year N+1 New adopters are taken from the population of non-skiers and dropouts move from active to inactive status. Readoption rates are applied to the population of inactive skier to estimate the number returning to active status each year (Figure 1).

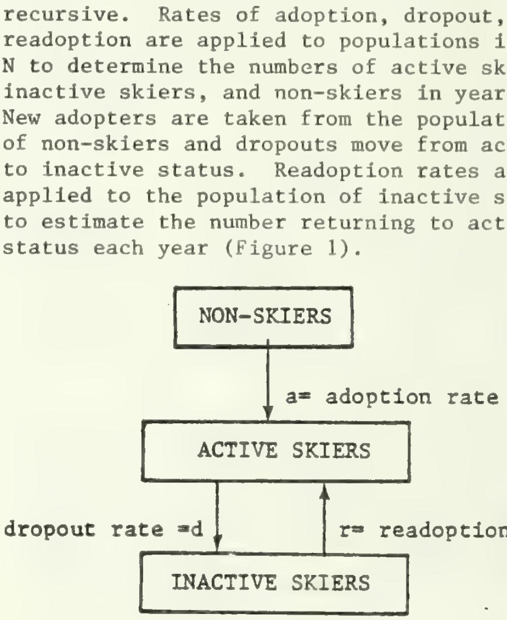


Figure 1. Skier Adoption, Dropout, ar Readoption

Adoption, dropout, and readoption rate are all age-specific. This permits the modeling of relationships between family li cycles and ski activity. Age is correlated with income, physical ability, lifestyle, marital status, presence of children of various ages within the household, etc. Th age serves as a proxy for a number of variables influencing ski participation decisio

Dropout rates also depend upon an individual's length of involvement in skiing. Dropout rates are relatively high for first time skiers and decline with increasing experience in the sport. The model also includes exogenously determined variables tha permits the user to adjust adoption and dropout rates over time due to age-independent factors. Entry and exit rates may be altered based upon snow conditions, price increases, travel restrictions, and other variables that have not yet been incorporat into the model. The flexibility in the mod ermits the addition of new variables and omponents in the future.

PARAMETER ESTIMATION

The ski forecasting model consists of two rincipal components: a population model and skier decision model. Parameters for the ohort-survival population model are the stan- ard fertility, mortality, and migration rates. he interested reader is referred to Pittenger 1976) and Shyrock (1971) for further details n estimating vital rates for populations.

Our concern here is primarily with the kier decision model. The key parameters re age-specific adoption, dropout, and re- doption rates for each year. Existing em- irical data is not well-suited to straight- orward estimation of these parameters. Time eries data to estimate changes in rates over ime are totally lacking. Adoption, dropout, nd readoption rates were therefore estimated sing a variety of both statistical and euristic techniques. Parameters were first stimated independently. Simulation experi- ents were conducted and parameters were sub- equently adjusted iteratively until model be- avior was deemed reasonable and selected odel outputs corresponded with empirical bservations. Inconsistency in empirical data ets required judgement in selecting those ariables to focus upon in statistical fitting rcedures.

ata Base

Parameter estimation and model validation raw upon two primary data bases on Michigan ownhill skiers. The first complete data on chigan skiers is provided by Leuschner (1970) a survey of the North Central region in 1968. 1978 Michigan skier market survey (Stynes, honey, and Spotts, 1980; Stynes and Mahoney, 80) provides the data most suited to develop- nt of the forecasting model. These two ars of fairly comprehensive surveys are pplemented by national survey data from Page (1978) where necessary, and from se- cted reports of estimates of skier volumes und in Domoy (1977) and Farwell (1977).

The 1978 Michigan skier market survey thered extensive data on adoption, inactiv- y, and withdrawal from downhill skiing. tive and inactive skiers were included in e design, and recall questions were used to timate the age and year of adoption and opout. This recall data forms the basis for timation of age-specific adoption and dropout es overtime. Where data was lacking, prod- life cycle and related theories were used fill in gaps.

Adoption Rates

The adoption rate for individuals in age group I for year N is given by a product of two terms:

$$a^N(I) = a_1^N * a_2(I)$$

$a_2(I)$ is the adoption rate for age group I in 1970, i.e., the percent of non-skiers adopting in the year.[2] a_1^N is an exogenously determined adjustment factor permitting the model user to adjust adoption rates over time.[3] Figure 2 plots the recommended values for a_1^N for those years N between 1950 and 1978. These were estimated from Stynes and Mahoney (1980).

$a_2(I)$ are age-specific adoption rates. These were estimated for 1970 by distributing new skiers into three year age groups using an empirical distribution measured by Stynes and Mahoney (1980). The age at adoption was calculated for 503 active and former skiers. The resulting distribution is plotted in Figure 3. These estimates represent skiers adopting between the years of 1946 and 1978 and will to some extent reflect the age distribution of the population over this period. We assume that the age distribution of adopters given by Figure 3 is constant over time and can be applied to any year to distribute new skiers by age. Empirical data supports this assumption.

Dropout Rates

Dropout rates include three components. The dropout rate for individuals age I with J years of experience in year N is given by:

$$d^N(I,J) = d_1(N) * d_2(I) * d_3(J)$$

Dropout rates depend upon the year (N), the age of the skier (I), and the number of years of experience (J). These three components are assumed to be independent and to enter multiplicatively. The assumption of independence between age and length of involvement is clearly invalid, but sufficient data did not exist to estimate a joint relationship of the form $d_4(I,J)$.

---

[2] 1970 was selected as a base year because of fairly accurate estimates for both population (1970 Census data) and numbers of new skiers (estimated from Leuschner 1970, Stynes and Mahoney 1980, and Farwell 1977).

[3] a_1^N for N=1970 should be approximately 1.0. Values of a_1^N larger than one yield higher adoption rates than those observed for 1970, while values less than one yield rates lower than the 1970 standard.

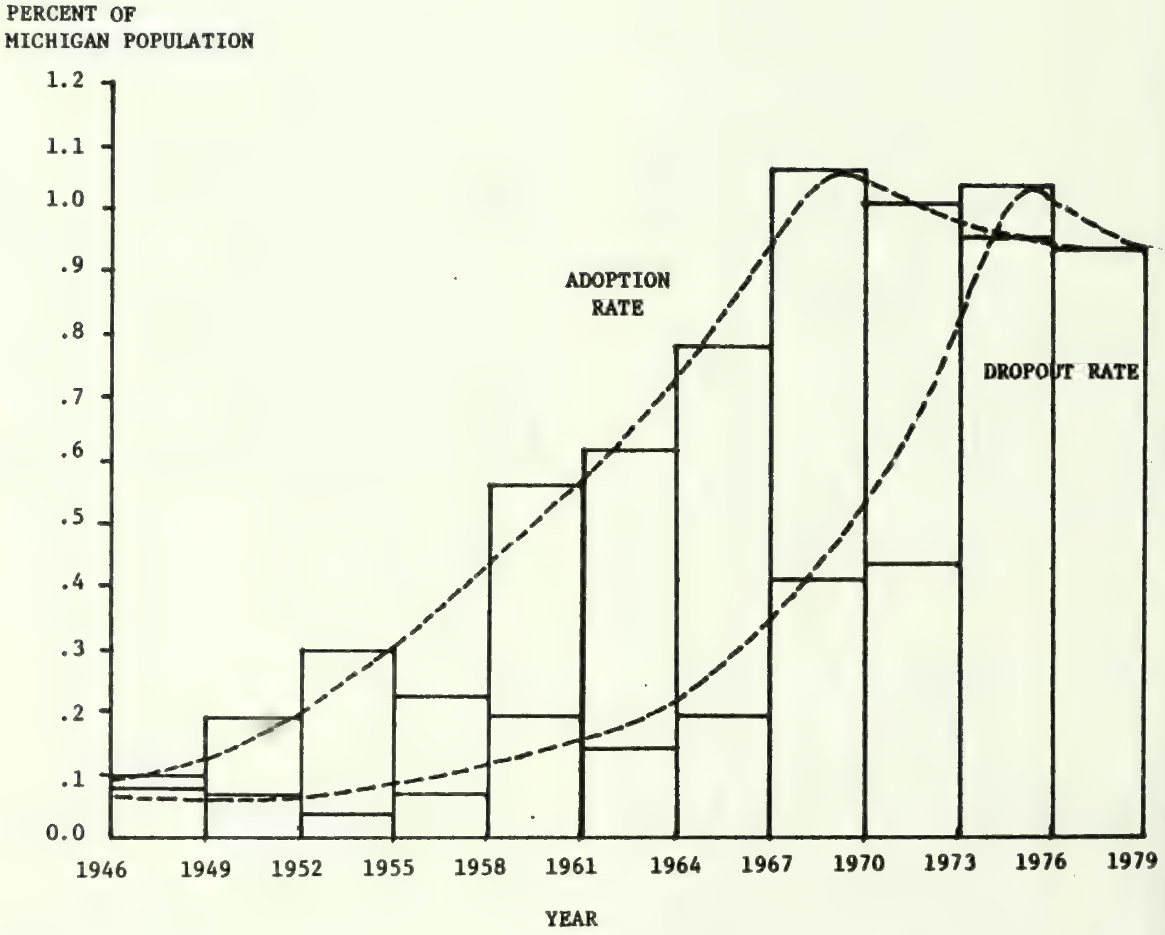


Figure 2. Estimated Adoption and Dropout Rates By Year

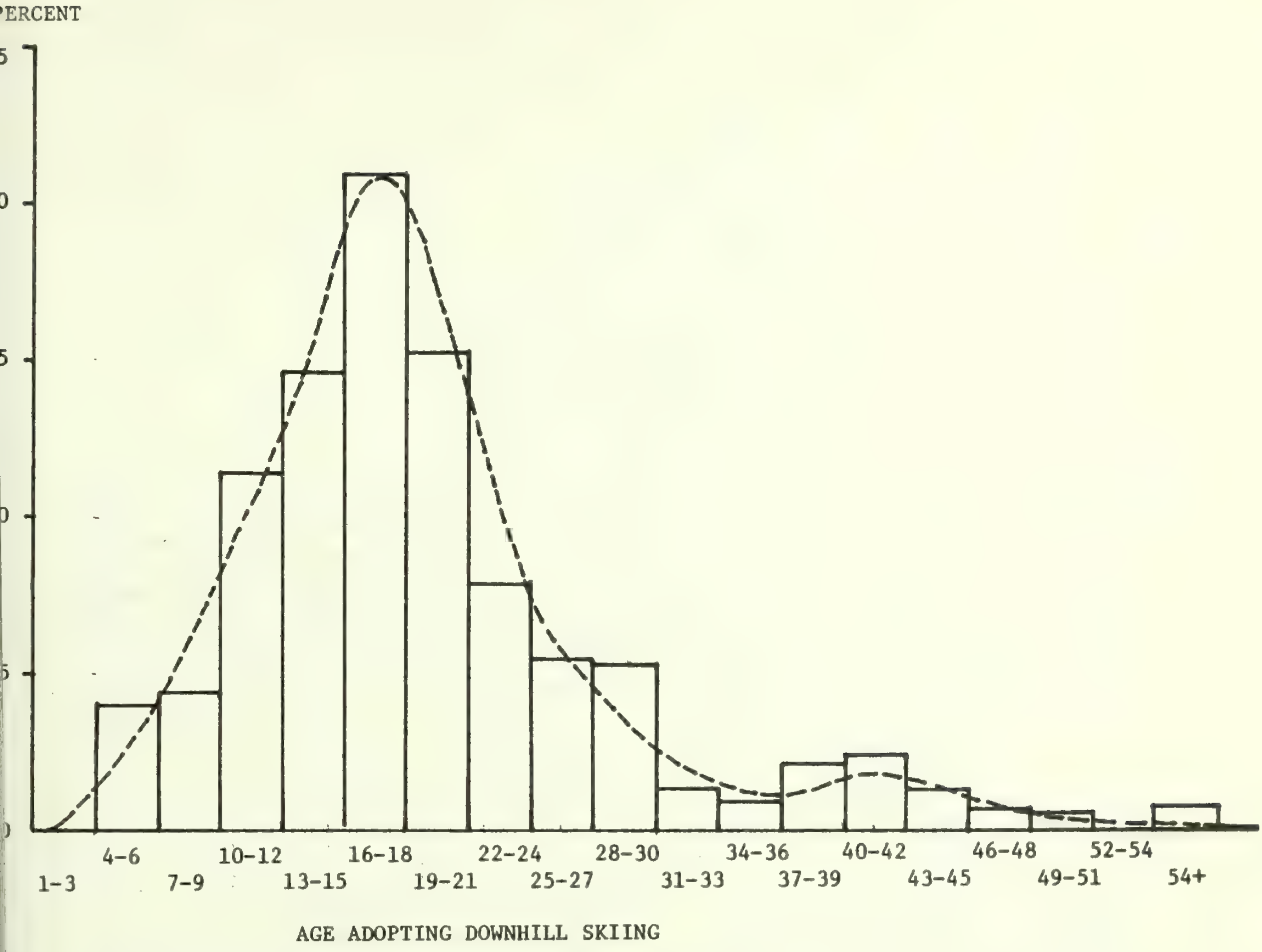


FIGURE 3. Distribution of Skiers By Age at Adoption

The first two components are directly alogous to the corresponding adoption func- ons, and are estimated in a similar manner. (N) is an exogenously determined variable rmitting the user to adjust dropout rates er time. $d_2(I)$ are age-specific dropout tes assumed to be independent of N and timated for the base year 1970. Figure 4 ves the distribution by age dropped for all active and dropout skiers surveyed in the 78 Michigan ski market survey. Figure 2 ots recommended values for $d_1(N)$. These timates should be used cautiously as they e based upon limited data.

No data exists to estimate $d_3(J)$, the lationship between dropout rates and length involvement in skiing. An inverse square ot function is assumed.

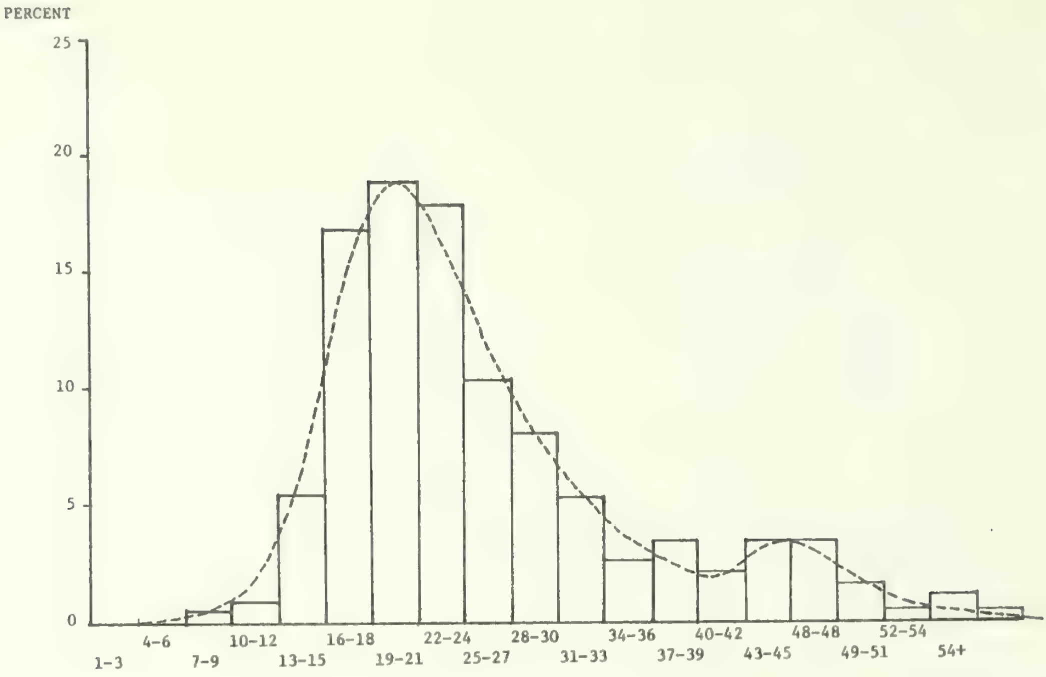
adoption Rates

There is little data on which to base timates of readoption. Age-specific re- option rates are based primarily upon the author's judgment and some simple experiments with the simulation model. It was assumed that readoption rates would roughly parallel adoption rates.

VALIDATION AND TESTING

Since model refinement and testing are still in progress we shall only briefly discuss validation here. It will suffice to indicate the general behavior of the model and illustrate the various model outputs. Shechter and Lucas (1978) provide a good discussion and summary of alternative methods for validating simulation models. Forecasting models offer an additional difficulty in that the "true" results are unknown.

The model's behavior is illustrated by first simulating from the year 1950 to the present and then examining forecasts to the year 2000 under alternative assumptions about the future.



AGE DROPPING DOWNHILL SKIING

Figure 4. Distribution of Inactive Skiers by Age when Last Skied

Simulating from 1950 to 1978

The year 1950 was selected as an initial year for downhill skiing in Michigan.[4] The model was initialized using 1950 Census data for non-skiers and begun with no active or inactive skiers. A 28 year simulation period was set. Selected model outputs over this 28 year period are summarized in Tables 1-3 and Figure 5.

Simulation model results were compared with empirical data from Leuschner (1970), Stynes and Mahoney (1980), and other relevant studies of Michigan skiers. The comparisons indicate that the model predicts quite accurately both the numbers of skiers and their distribution by age and length of imvolvement. Leuschner estimates about 128,500 skiers in 1968 (compared with model prediction of 140,700). Leuschner included only skiers 13 years of age and older while the model keeps track of skiers 7 years and older. By 1975 active skier numbers reach 263,000. Estimating about 9 days of skiing per skier that year, this compares favorably with Domoy's (1977) estimate of 2.2 million lift tickets sold in Michigan (skier days). Growth rates of about 10% in the early 1970's drop to about 4% by 1978, resulting in just over 300,000 skiers in 1978.

Distributions of skiers by age and length of involvement compare favorably with the 1978 Michigan survey after corrections for population differences. (The Michigan survey only interviewed skiers 18 years of age and older). The 1978 Michigan skier market survey estimated that 35% of former skiers had skied only one year prior to quitting (compared with 37% predicted by the model). Also the ratio of active skiers to inactives in 1978 is almost exactly 1:2, precisely the ratio measured in the 1978 survey.

In summary, the model predicts skier numbers and characteristics for the year 1978 quite well. Of course some of this same data was used in estimating model parameters so that these comparisons do not provide a true test of the model. This will require future measurements of Michigan's skier population in order to test the model's predictive abilities.

---

[4] We know both ski resorts and skiers existed prior to 1950, but it is assumed that the numbers of skiers in 1950 were small enough compared with growth over the next decade to have little effect on model outputs by 1968.

Table 1. Downhill Ski Simulation 1951-1978

Numbers of Skiers (Thousands)

Year	Active Skiers	Inactive Skiers	Adopters	Dropouts	Readopters
1951	6	0	6	0	0
1952	9	3	7	3	0
1953	12	8	8	5	1
1954	16	13	8	6	1
1955	20	20	10	8	1
1956	24	26	11	9	2
1957	29	34	13	11	3
1958	35	43	14	13	4
1959	41	53	16	15	5
1960	48	64	18	18	7
1961	56	77	20	21	8
1962	65	92	23	24	9
1963	75	108	26	27	11
1964	87	126	29	31	13
1965	99	146	32	36	15
1966	111	169	34	40	18
1967	125	193	38	45	20
1968	140	220	42	50	23
1969	157	249	46	56	26
1970	175	282	50	62	30
1971	194	317	54	69	33
1972	213	356	57	76	37
1973	232	397	59	83	42
1974	248	439	58	89	46
1975	263	482	57	93	51
1976	277	524	56	97	55
1977	290	566	54	101	59
1978	301	606	51	103	63

Table 2. Downhill Ski Simulation 1951-1978

Distribution of Active Skiers

	AGE					YRS EXPERIENCE		
Year	7-12	13-18	19-24	25-30	31+	1	2	9+
			percent				percent	
1951	16	25	27	16	14	100	0	0
1952	16	25	26	16	14	74	25	0
1953	16	25	26	16	14	62	26	0
1954	16	25	26	16	14	54	26	0
1955	16	26	26	16	14	49	25	0
1956	15	26	27	16	14	45	25	0
1957	15	26	27	16	14	44	23	0
1958	15	26	27	16	14	41	23	0
1959	14	26	27	16	14	39	23	1
1960	14	27	27	16	14	38	22	1
1961	13	26	27	17	14	36	21	1
1962	13	25	27	17	15	35	21	2
1963	13	26	27	17	15	34	21	3
1964	13	26	27	17	15	33	20	3
1965	12	26	28	17	15	32	20	4
1966	11	25	28	18	15	31	20	5
1967	11	25	28	19	16	30	19	5
1968	10	25	28	19	16	30	19	6
1969	10	25	28	19	16	29	19	7
1970	9	24	29	19	16	28	19	7
1971	8	24	29	20	17	28	18	8
1972	8	23	29	21	17	26	18	9
1973	7	22	29	21	18	25	18	9
1974	7	21	30	21	19	23	18	10
1975	6	20	30	23	20	22	17	11
1976	6	18	29	24	21	20	17	12
1977	5	17	29	24	22	18	16	13
1978	5	15	28	25	24	17	15	15

Table 3. Downhill Ski Simulation 1951-1978

Distribution of Inactive Skiers

	AGE					YRS EXPERIENCE		
Year	7-12	13-18	19-24	25-30	31+	1	2	9+
			percent				percent	
1951	0	0	0	0	0	0	0	0
1952	11	21	30	17	19	100	0	0
1953	10	20	30	18	20	87	12	0
1954	9	19	30	18	22	79	16	0
1955	8	19	29	19	23	74	18	0
1956	7	18	29	19	24	69	20	0
1957	7	18	29	19	26	65	20	0
1958	6	17	28	19	27	63	20	0
1959	6	17	27	20	28	60	21	0
1960	5	17	27	20	28	58	21	0
1961	5	16	27	20	29	56	21	0
1962	5	16	27	21	30	55	21	0
1963	5	16	26	21	30	53	21	1
1964	5	16	26	20	31	52	21	1
1965	4	15	26	20	31	51	21	1
1966	4	15	26	20	32	50	21	1
1967	4	15	26	21	33	49	21	1
1968	4	15	25	21	33	48	20	2
1969	3	14	26	21	34	47	20	2
1970	3	14	26	20	34	46	20	2
1971	3	13	25	21	35	45	20	3
1972	2	13	25	22	36	44	20	3
1973	2	12	25	22	37	43	20	3
1974	2	11	25	22	37	42	20	4
1975	2	11	25	22	38	41	20	4
1976	2	10	24	23	39	40	20	5
1977	1	9	23	23	41	38	20	5
1978	1	8	22	23	43	37	19	6

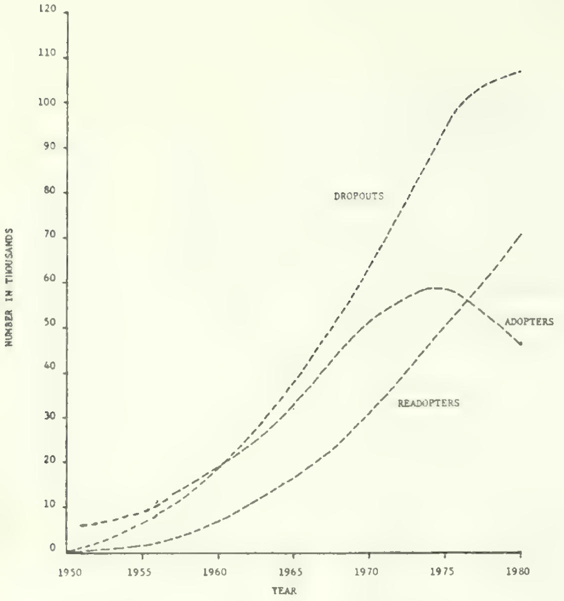


Figure 5. Growth in Downhill Ski Adoption, Dropout and Readoption 1950-1980.

However, the model's ability to begin in 1950 with no skiers and simulate 28 years ahead to accurately describe Michigan's 1978 active and inactive skier populations is very encouraging.

Formal comparisons of model outputs with empirical data bases raises a number of questions. First of all, the model produces a much greater volume of quite specific information than can be found in any empirical study. The model can predict, for example, the numbe of active or inactive skiers in 1962 who are 10 years old and have been skiing two years. No one would ever attempt to estimate this figure empirically. Secondly, empirical data generally does not precisely correspond with the model's outputs and survey data is subject to perhaps quite significant measurement errors. Differences in populations (age restrictions in surveys, for example), recall errors, and the manner in which surveys define "active" skiers are just a few of the problems that arise. Thus, in comparing model outputs with empirical data one cannot confidently assume that the empirical figure is the "true" measure. Rowan (1980) has noted the inconsistency in estimates of numbers of skiers nationally. In examining data on Michigan skiers, we uncovered similar inconsistencies.

Forecasting Experiments

Although additional model experimentation, refinement, and testing are required before the model can be used in policy analysis, we can illustrate the model's potential contribution by means of four simple experiments. In each case the model is initialized for the year 1978 and forecasts are generated through the year 2000 under alternative assumptions. The scenarios were selected to illustrate a range of possibilities.

Forecast #1 takes an optimistic view assuming that growth rates observed in 1970 will continue to the year 2000. Even under this optimistic scenario the numbers of skiers peak at 414,000 by the year 2000. The curve exhibits and S-shaped (logistic) pattern characteristic of the product life cycle (Kotler 1976). The eventual decline is in part due to an aging population structure, and also a result of market saturation. This scenario yields an active skier population in the year 2000 that is significantly older and more experienced than today's skiers.

Forecast #2 assumes a reduction in both dropout and adoption rates. This would characterize a sport with more limited entry, but with existing skiers remaining active a little longer. Skiers reach a peak in 1990 of about 373,000 and then decline to about 350,000 by the year 2000. The pattern is similar to scenario #1, but peaks a decade earlier and at a lower level.

Forecast #3 assumes a decline in adoption rates and an increase in dropout rates. It reflects a general diminishing in popularity of the sport. Under these assumptions numbers of active skiers fall to 265,000, receive a small boost from the second "baby boom," and then drop to 240,000 by the year 2000.

Forecast #4, the most pessimistic scenario, assumes that adoption rates fall to one-fifth of their 1970 values and dropout rates increase by 25%. Skier numbers drop off immediately and rapidly to less than 200,000 by 1990 and to 139,000 by the year 2000. The scenario illustrates that even under quite radical assumptions, the downhill ski market has a certain degree of inertia that will provide a degree of stability. (Figure 6)

These scenarios have illustrated only the simplest of forecasting experiments. The user may also adjust readoption rates or age-specific adoption and dropout rates to simulate skier numbers under more complex assumptions about the future. For example, a promotional campaign aimed at returning inactive skiers, or attracting skiers from older age groups could be simulated by adjusting the relevant age-specific readoption or adoption rates for years after 1980.

Experiments can also examine more datiled characteristics of future downhill ski populations. Under most scenarios future skier populations are more experienced and older than

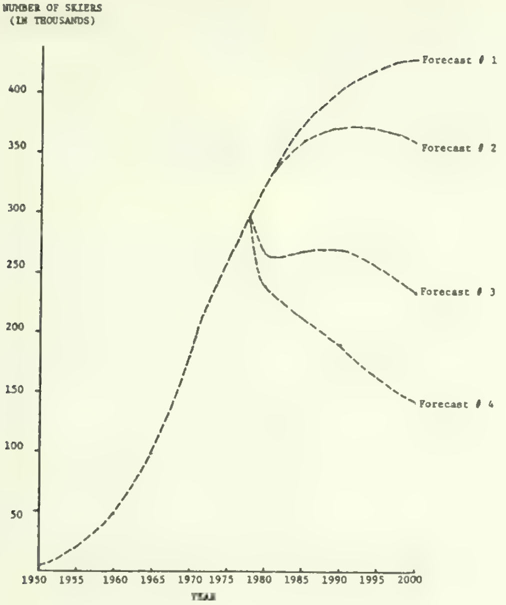


Figure 6. Downhill Ski Forecasts to the Year 2000.

today's downhill skiers. This suggests changes in marketing and ski area offerings. One may test the effects of alternative population scenarios. In one experiment the population and age structure were fixed at 1950 levels and skier numbers were simulated to 1978. This resulted in 100,000 fewer skiers than under observed population growth, indicating that approximately half of the growth in numbers of skiers since the mid-sixties can be attributed to population changes. The remainder is due to expansion in supply of skiing opportunities and increased popularity of the sport.

FUTURE MODEL DEVELOPMENT AND TESTING

Although the simulation model is operational, more testing is needed before the model can be used directly in policy analysis. Sensitivity analyses should be conducted on model parameters in order to better understand the effects of small changes in parameters on model results. This will also pinpoint key data needs of the model and guide future data collection efforts. Improved time series data on skier visits and numbers should be collected in a consistent manner in order to evaluate the predictive ability of the model and to revise and update parameter estimates. Model testing should be conducted with ski area personnel, who have a more intimate knowledge of the industry.

As with most simulation models, the number and variety of possible refinements is virtually endless. We have interrupted model testing and development in order to summarize our progress to date. There are four additions to the model that we recommend:

(1) Adding a weather variable to account for good and bad snow years

(2) Adding growth in potential substitutes like cross country skiing

(3) Predicting skier days in additon to numbers of skiers

(4) Development of a regional model

The development of a regional model is the most complex and costly and also of the greatest potential benefit. This would involve dividing the state into regions, expanding the population model to a regional one, estimating demand and supply of skiing in each region, and then predicting origin-destination patterns using a trip distribution model.

The regional model would require more data on skier trip patterns and population change within each region. Such a model could provide forecasts of more use to individual ski areas and assist in making regional development and promotion decisions.

GENERAL MODEL EVALUATION AND CONCLUSIONS

Although the model is still in a testing phase, a number of advantages over alternative forecasting approaches are already evident. Not to be overlooked is the knowledge and insight gained in the model development process itself. Raser, Campbell, and Chadwick (1970) cite five ways that simulation modeling contributes to theory development:

(1) Confrontation - modelers must confront what they do not know

(2) Explication - simulation modeling forces precise specification of relationships and assumptions

(3) Expansion - it forces a broadened, more comprehensive view

(4) Involvement - it stimulates the researcher to fill in gaps

(5) Serendipity - simulations reveal new problems, new solutions and new hypotheses

Our experience with this model confirms these advantages of computer simulation models.

The model provided a framework for evaluating the comparability and consistency of past empirical studies of downhill skiing. Many ambiguities and inconsistencies in reported market studies and forecasts were identified. Efforts to estimate model parameters and validate the model uncovered a number of gaps in existing data bases. Concentration upon active skiers in market surveys has resulted in a limited understanding of inactivity and downhill ski entry and exit decisions.

How do dropout rates change with length of involvement? Under what circumstances and at what ages do individuals tend to adopt or drop the sport? Is Michigan a net importer or exporter of downhill skiers? What are the short and long term impacts of a poor snow year on the sport? What effects will growth in cross country skiing and changing energy conditions have on downhill skiing's future? These and other questions arose during stages of model development, parameter estimation, validation, and refinement. Answers to these types of questions from future research can be directly translated into improvements and refinements of the simulation model. The simulation model therefore plays a much stronger role in the research process than one generally finds with more traditional types of models.

In concluding we discuss what we view as the five most important features of the model and then briefly address model limitations.

(1) The model is dynamic. It not only can predict change over time, but its basic structure captures the processes of entry and exit within the ski market. Timelags, feeback effects, and other dynamic features of the model can be explored to better understand change in recreation activity markets. In particular, the model illustrates a number of general growth concepts and theories including the product life cycle, diffusion theories, market saturation, and consumer involvement cycles. These processes may be generalized to other activities.

(2) The model is both simple and logical. Adoption, dropout, and readoption of activities are easily understood processes. Complexity is introduced in the model primarily in the estimation of critical model parameters. This permits a separation of the more technical aspects of the model from the more easily understood, making the model easy to use and understand for practitioners, while permitting researchers to explore more detailed and complex features of the model and the system being modeled.

(3) The model is completely general. It could be applied to virtually any activity or product in any state or region. One must simply add a population model for the region in question and estimate adoption, dropout, and readoption rates over time. The generality of the model facilitates the transfer of findings about recreation activity dynamics across regions and activities.

(4) The model is extremely flexible. It can generate an infinite array of outputs in a variety of forms. Components may be easily added to the model. Thus, it provides a framework for both guiding and integrating future research on recreation participation decisions.

(5) Finally, the model may be used in a variety of settings. Researchers will find it useful in suggesting hypotheses and in exploring dynamic aspects of the ski market. The model can also help in directing future data collection efforts by identifying gaps or inconsistencies in current data and suggesting the relative importance of precision in the measurement of different variables. For ski area personnel and students, the model may be used in a gaming format to explore futures and to test the relative effects of alternative promotional and development strategies. The effects of population change can be dramatically illustrated with the model.

Since the model in its current state is a statewide aggregated model, it cannot be tied directly to individual ski area decisions. It can however contribute to broader statewide and industrywide policy and promotion decisions. While the model could be disaggregated into a regional model including ski travel behavior, this refinement would require considerably more modeling and data collection.

Limitations of the model relate primarily to the lack of data that are ideally suited for parameter estimation or validation. The model requires estimates of adoption, dropout, and readoption rates over time. Future research should develop models to predict these rates based upon social, economic, and environmental variables. Such relationships could then be added to the existing model to internalize relationships that must presently be estimated outside the model.

Development of the model cost about $5000. A similar amount was required for the 1978 Michigan ski market survey, which in addition to gathering data to estimate model parameters, also produced two ski marketing reports (Stynes, Mahoney and Spotts 1980, Stynes and Mahoney 1980). A typical forecast to the year 2000 costs less than a dollar in computer costs and generates a wealth of data. Computer simulation models do not have to be expensive.

LITERATURE CITED

Cesario, Frank J. 1975. A Simulation Approach to Outdoor Recreation Planning. J. of Leisure Research 7(1):38-52.

Cicchetti, C.J. 1973. Forecasting Recreation in the United States. D.C. Heath. Lexington, Mass.

Domoy, Francis. M. 1977. An Employment Analysis of the Michigan Ski Industry. Michigan State University Agricultural Experiment Station Research Report No. 329. East Lansing.

Ellis, J. and C. VanDoren. 1967. A Comparative Evaluation of Gravity and Systems Theory Models for Statewide Recreation Flows. J. of Regional Science 6:57-70.

Farwell, Ted and Associates. 1977. Skiing Demand and Supply Study for the Lower Peninsula of the State of Michigan. Report prepared for the U.S. Forest Service, Huron-Manistee National Forest, Cadillac, Michigan.

Hamilton, H.R. et al. 1969. Systems Simulation for Regional Analysis: An Application to River Basin Planning. Cambridge, Mass.: MIT Press.

Ladany, Shaul F. (ed). 1975. Management Science Applications to Leisure Time Operations. American Elsevier. New York.

LaPage, Wilbur F. 1978. Growth Potential of the Skier Market. Review Draft. USDA Forest Service, Northeastern Forest Experiment Station. Broomall, PA.

Leuschner, William A. 1970. Skiing in the Great Lakes States: The Industry and the Skier. USDA Forest Service Research Paper NC-46. North Central Forest Experiment Station. St. Paul, Mn.

Meadows, Donella H., Dennis L. Meadows, Jorgen Randers, and William W. Behrens III. 1972. The Limits to Growth. Potomac Associates. New York.

oeller, George H. and Herbert E. Echelberger. 1974. Approaches to Forecasting Recreation Consumption. Outdoor Recreation Research: Applying the Results. U.S. Forest Service General Technical Report NC-9. St. Paul, Mn.

oeller, George H., Elwood L. Shafer, and Russell Getty. 1977. Leisure Environments of Tomorrow. Outdoor Recreation: Advances in Application of Economics. US Forest Service General Technical Report WO-2. New Orleans, La.

Pittenger, Donald B. 1976. Projecting State and Local Populations. Ballinger: Cambridge, MA.

Raser, John R., Donald T. Campbell and Richard W. Chadwick. 1970. Gaming and Simulation for Developing Theory Relevant to International Relations. General Systems 15:183-203.

Rowan, David. 1979. The Great Numbers Game. Ski Area Management. 18(3):14-18.

Shechter, Mordechai and Robert C. Lucas. 1978. Simulation of Recreational Use for Park and Wilderness Management. John Hopkins, Baltimore.

Shryock, Henry S., Jacob S. Siegal, and Associates. 1971. The Methods and Materials of Demography. Volume 2. US Department of Commerce, Bureau of the Census. Washington, D.C.

Smith, V. Kerry and John V. Krutilla. 1976. Structure and Properties of a Wilderness Travel Simulator. John Hopkins, Baltimore.

Stynes, Daniel J. 1979. A Simulation Approach to the Determination of Recreation Carrying Capacity. Proceedings National Workshop on Computers in Recreation and Parks. August 1-3, 1979. St. Louis, Missouri. National Recreation and Park Association.

Stynes, Daniel J., Edward M. Mahoney and Daniel M. Spotts. 1980. Michigan Downhill Ski Marketing Study: A Comparison of Active, Inactive, Dropout and Potential Skier Market Segments. Michigan State University Agricultural Experiment Station Research Report 389.

Stynes, Daniel J., and Edward M. Mahoney. 1980. Michigan Downhill Ski Marketing Study: Segmenting Active Skiers. Michigan State University Agricultural Experiment Station Research Report No. 391. East Lansing.

Stynes, Daniel J., and Kevin Szcodronski. 1980. Predicting Trends in Michigan Snowmobile Populations Using Product Life Cycle and Diffusion of Innovations Theories. Proceedings of the First North American Symposium on Dispersed Winter Recreation. University of Minnesota, St. Paul. (to appear May 1980).

Stynes, D.J., M.I. Bevins, and T.L. Brown. 1980. Trends or Methodological Differences? Proceedings 1980 National Outdoor Recreation Trends Symposium. Northeastern Forest Experiment Station. Broomall, PA.

West, Patrick C. 1977. A Status Group Dynamics Approach to Predicting Participation Rates in Regional Recreation Demand Studies. Land Economics 53(2):196-211.

"THE DYNAMICS OF RECREATION PARTICIPATION: SKI TOURING IN MINNESOTA"

Timothy B. Knopp, Associate Professor
University of Minnesota
College of Forestry
Department of Forest Resources
110 Green Hall
1530 North Cleveland Avenue
St. Paul, MN

G. Ballman
University of Minnesota
College of Forestry
Department of Forest Resources
110 Green Hall
1530 North Cleveland Avenue
St. Paul, MN

L. C. Merriam
University of Minnesota
College of Forestry
Department of Forest Resources
110 Green Hall
1530 North Cleveland Avenue
St. Paul, MN

ABSTRACT:

A realistic model or framework for the analysis of recreation behavior must be both comprehensive and dynamic. Most attempts to explain recreation behavior are static in that they do not allow for changes in the character of an activity or the evolution of a participant's involvement. Even predictive models tend to assume that relationships remain constant over time. A dynamic model is especially critical in the analysis of new, rapidly evolving forms of recreation.

The recent, rapid growth of ski touring in Minnesota provides an ideal opportunity to document and analyze the dynamics of participation. The parallel growth of snowmobiling is a basis for comparison and the chance to examine the effect of alternative forms of recreation on participation.

Questionnaire responses from a random sample of Minnesota ski tourers (1978) provided data used to examine two important aspects of internal dynamics. First, as the dominant image of ski touring changes we can expect a corresponding change in the motivations of persons taking up the activity. Second, as skiers increase in skill and experience they will seek more challenging situations and a greater variety of opportunities. These hypotheses were tested by comparing recent adherents to more experienced skiers.

Newer adherents were more likely to be female and less likely to be college graduates. Comparisons of age and residency were inconclusive. Participation in other forms of winter recreation relate to ski touring in a variety of ways. A growing percentage of those taking up ski touring have participated in snowmobiling. The pursuit of exercise and the outdoor environment have consistently been primary reasons for taking up the sport. The influence of friends appears to be an increasing factor. While self-rated skill level is directly correlated with years of experience, there is only a slight tendency for new skiers to prefer well groomed and marked trails, and a tendency to label longer trails and remote areas undesirable.

INTRODUCTION

A good deal of research effort has been directed toward predicting trends in the rate of participation in various recreational activities. To a large extent these have relied on extrapolations or empirically derived correlations between participation rates and the socio-economic characteristics of a population. We are now beginning to take the next step, i.e., the identification of mechanisms which explain changes.

Several individuals, including Christy (1970) and Meyersohn (1957), have described what they feel are the important determinants of "mass" recreation or "fads". More recently West (1977) developed an innovative "status group dynamic approach to predicting participation rates". While the latter goes a long way toward explaining and quantifying change, it relies heavily on the validity of the status concept and the symbolic function of recreation activities.

Motivational research has contributed a great deal to our understanding of why people participate in various activities. In particular the recent models and scales developed by Driver and Brown (Driver 1977); (Driver and Brown 1975) have brought this approach to a high level of sophistication. Tinsley (1977; 1978) has also contibuted a great deal to an understanding of motivations and need satisfaction. However, many of the concepts in motivational research are somewhat static in that they seldom allow for changes within the individual or in the character of the activity.

There is an obvious need for a comprehensive, dynamic framework which identifies factors and relationships effecting changes in recreation participation. We can begin by making unstructured, but detailed, observations of specific activities over time. Once a skeleton framework has been developed we can fill it in with statistical analyses of the linkages and mechanisms operating within the framework.

The recent, rapid growth in the popularity of ski touring in Minnesota provides an excellent opportunity for the approach outlined above. Although ancient in origin, the activity is relatively new in terms of mass participation in the United States. Some indication of the significance of this development can be ascertained by comparing the 1977-78 season Minnesota Department of Natural Resources (MDNR) estimate of 500,000 participants based on a statewide, random survey, with the few hundred to a thousand ski tourers present in 1965. Current figures show an annual growth rate of from 20 to 30 percent (Ballman, 1979).

We will begin by describing the various mechanisms believed to be operating in the evolution of ski touring in Minnesota. Many of these mechanisms can be abstracted in the sense that they probably operate to a greater or lesser extent in the history of any recreational activity. As far as is possible these mechanisms will be systematically linked within a comprehensive framework.

Next we will utilize recent data from a statewide survey of ski touring participants in Minnesota to test some of the mechanisms suggested in the first part. No data set can completely encompass the complexities of recreation participation. It is critical that any statistical analysis be proceeded by the development of a comprehensive framework so that the data can be kept in perspective and we can avoid the temptation to adopt narrow, self-contained explanations of behavior.

A FRAMEWORK FOR ANALYSIS

This framework is derived from unstructured and structured observation, the contributions of previous research, and an intuitive notion of recreation behavior. The framework consists of the various mechanisms which can influence recreation participation and the patterns of change over time. The growth and evolution of ski touring in Minnesota will be used to illustrate the framework. In this initial discussion no attempt will be made to quantify the effect of any specific factor, this will be left to an analysis of survey data. Some difficulties will be encountered where the same factor can influence different persons in dramatically opposite ways.

Defining Participation

Before we can begin to describe the factors influencing participation we must deal with the meaning of the term participation. Participation has both quality and quantity dimensions. The latter can be expressed in terms of numbers of individuals, man-hours, visitor days, or miles skied. These measures must be defined still further to be operationalized. If we are concerned with numbers it is necessary to list the criteria for inclusion; e.g., who do we consider a ski tourer? Anyone who has ever skied, or those who have skied a minimum number of miles in the past season. For some purposes "dollars invested" may be an appropriate criteria.

Man-hours also requries a more explicit definition. Do we include travel or resort time, or only the hours on the trail? A visitor day has been standardized by the U.S. Forest Service and the National Park Service as an expression of occupancy. Although "visitor day" is a practical measure for making some crude comparisons, it is generally insensitive to subtle changes in the character of participation.

The quality dimension pertains to both the nature of the activity and the environment in which it takes place. Racing is a far differenet experience than casual touring or winter camping--all of which can take place in the same area. An urban park and a remote wilderness each provide a distinctly different experience even where the physical motions are the same.

We will not elaborate further on a definition of participation. The importance of explicit definitions will become more obvious as the discussion proceeds. Suffice it to say that any definition must be appropriate for the change or comparison which is being described and the purpose to which the analysis will be applied.

Inherent Appeal

Any analysis of participation dynamics must begin with a thorough familiarity with the inherent appeal of the activity(s) in question. There are three primary characteristics to consider: novelty, variation, and efficiency. Novelty is a function of "newness" or contrast with other pastimes. Our example, ski touring, has characteristics in common with a number of other forms of recreation. It can provide some of the thrills of downhill skiing; it allows access to many of the same environments as does snowmobiling; it can offer health benefits similar to running. In part the "uniqueness" of ski touring probably lies in the combination of benefits it can furnish.

But, in addition, ski touring has some subtle attributes which are revealed only by a more intimate acquaintance with the activity. Ski touring is a form of exercise that can be performed with "grace" and "dignity". By comparison, jogging is often associated with smelly sweat clothes and an ungainly shuffle. Another alternative, the bicycle, still has connotations of a child's toy for many adults. Ski touring provides the means to ease gently into an exercise routine; the transition from a leisurely stroll to a strenuous workout is gradual and without the distinct change of gait which separates walking from running. These, and other characteristics which are not obvious to a casual observer, may be important determinants of the activity's appeal.

Variation refers to the range of experiences possible within the scope of an activity. Ski touring can vary from a leisurely stroll to strenuous competitive racing. Access to different environments also contributes to variation. Ski touring, because it is relatively unobtrusive, is tolerated in residential areas and fragile wilderness areas. A ski tourer can choose between solitude and the mayhem of a mass start tour-race. Complementary facilities also add to variety. Lodging may consist of a hole in a snow drift or a luxury resort.

Efficiency is simply the net result of a tally of costs and benefits. Costs may include monetary investment, time, energy, inconvenience, negative image or stigma, and possible loss of social relationships. Variation contributes the most to the benefit side of the ledger. The value of a specific benefit, however, will depend on individual and collective needs.

Inherent appeal is most easily comprehended relative to alternative forms of recreation. All in all, ski touring probably rates quite high compared to the major winter outdoor alternatives currently available.

Sources of New Participants and Dropouts

Participation in ski touring is often thought of in terms of the number of individuals who have skied during the current season. Generally, numbers fluctuate for one of two reasons: 1) individuals enter or leave segments of the population with varying rates of participation, or 2) individuals are attracted to or repelled by the activity due to changes, real or perceived, in its character.

The character of an activity is the product of opportunities (facilities and natural conditions), the commercial impetus and the behavior of those participating.

The first mechanism can be understood fairly easily by examining the correlation of participation with traditional socioeconomic cohorts. For example, certain individuals will begin to participate at a minimum age and drop out when they consider themselves to old. Position in the family or career cycle also affects participation in somewhat predictable ways. Although these mechanisms are always operating, they can be used to explain or predict change only when an activity has stabilized in respect to the kinds of opportunities available and the image it presents; this is definitely not the case with ski touring during its recent evolution.

Ski touring began as a relatively obscure form of recreation often confused with downhill skiing. It was, and to some extent still is, perceived as the blind men described an elephant. Some thought it was cross-country racing; others viewed it as bushwacking through remote, untracked wilderness. Few people understood the full range of opportunities the activity could provide.

At the same time real changes were occurring. The sport grew more visible--via word of mouth, popularized articles and deliberate promotions on the part of organizations such as the United States Ski Association and local ski touring clubs. Later the commercial establishment joined the efforts to promote ski touring. While all segments of the population are affected by the increase in visibility, we cannot expect the effect to be equal in magnitude across the population. The better informed individuals are the first to become aware of any new opportunity. As an activity becomes generally well known other segments of the population may account for an increasing portion of new participants.

Opportunities in the form of areas and physical facilities have also changed. Marked and groomed trails became more plentiful. Beginning in the early 1970's "citizens' tour races" were organized and promoted. Increases in trails and areas did not keep pace with growing numbers; consequently skiers confronted crowds which weren't experienced by their predecessors. The image of ski touring as a social event became more pronounced.

Ski touring equipment has also evolved. Tough, easily maintained fiber-glass skis became gnerally available in the mid to late 1970's. Waxless skis appealed to the casual participant. Lightweight poles and bindings added to the array of choices. For some the refinements in equipment make the activity easier; for others the equipment itself may be an attraction.

All of these changes meant that ski touring was not the same activity it was during the earlier stages of its development. Some would find the activity more appealing because large numbers of participants had demonstrated that it is "acceptable" and beneficial. The enthusiasm of others may have waned because it is no longer as exclusive and uncrowded trails are more difficult to find. The net effect has obviously been positive. In spite of any dominant image, the full range of experiences is still available.

External Factors

Recreation behavior does not exist in a vacuum. Independent changes occurring in society can act to discourage or encourage participation. These include economic trends, value sets, the environmental setting and alternative forms of recreation.

An affluent society can afford more expensive playthings; conversely, hard times may stimulate interest in less costly activities. Ski touring requires a smaller monetary investment than some of the competing outdoor winter recreation activities and therefore may be relatively favored by a general reduction in per capita buying power. Participants often cite low cost as a motivating factor. It is interesting to note that ski touring experienced an earlier resurgence during the depression years.

Value trends affect the image associated with a form of recreation. To the extent that people are really concerned about the environment, the energy crisis and the consumption of resources they may adopt forms of recreation which they perceive as consistent with their beliefs. The choice of recreation may be in part a genuine effort, and in part a symbolic gesture. Ski touring is considered to have a relatively low impact on the environment and a beneficial effect on health; thus the magnitude of these trends can be expected to influence participation.

Ski touring may also be considered consistent with current efforts on the part of some to become independent of complex, interdependent socio-economic systems. Some feel less vulnerable if their recreation does not depend on foreign oil and highly technical machines.

There is considerable evidence that the environmental setting of the home and workplace has an influence on the selection of a recreational activity (Knopp, 1972). Deficiences in these settings might be expected to create needs; compensation may be sought in the recreation experience. It is difficult to document this influence because it is almost impossible to control for visibility and means which may mask its effect.

The growth in ski touring may be associated with a growth in confinement and restraints imposed by urbanization and winter itself. Ski touring provides access to a vast resource of open space, nature, and freedom.

Alternative forms of recreation may complement and reinforce participation, or they may compete for time and other resources. The latter can occur in two ways: first, a direct competition for participants; and second, they can preempt space and resources, thus reducing opportunities. No discussion of ski touring would be complete without reference to the parallel growth in snowmobiling.

In a practical sense, snowmobiling made its appearance a few years before ski touring (major growth took place in the late 1960's). For this reason the activity gained a large number of adherents who _may_ have chosen ski touring if that alternative had been equally visible. Furthermore, large areas of land and financial resources were allocated to snowmobiling, thus affecting the opportunities for ski touring experiences. Another possible relationship is that the confidence and skills learned from snowmobiling provided a pool of winter acclimated persons who could easily transfer into ski touring. The extent of these effects may be impossible to measure, but the example does serve to illustrate the importance of timing and the sequence of exposure to alternative forms of recreation.

Other forms of recreation have had a less dramatic relationship. Downhill skiing also competes for participants and their time; at the same time it also furnishes new adherents who convert entirely or partially to ski touring because of cost, crowded lift lines or threat of physical injury. The popularity of running contributes to a population which is physically better able to enjoy ski touring and is likely to seek a winter supplement to their training program. On the other hand, heavily committed runners may be reluctant to devote any effort to an activity which doesn't directly benefit their running ability.

We have discussed only a few of the most obviously related alternatives. Every other form of recreation will have some effect on participation. To cite one more example. Television may be considered a direct competitor--and yet, some have argued that coverage of the winter olympics stimulated many to take up ski touring.

Internal Dynamics

So far we have focused on factors which determine whether an individual participates in a given form of recreation. Profound changes also occur after an individual joins the ranks of participants. Some of these changes occur independently of participation and were included in our reference to sources of new participants and dropouts resulting from transfer from one socio-economic segment of the population to another. Here we will point out changes brought about by participation itself.

One change is an increase in skill, knowledge and confidence. Ski tourers, for example, might be expected to seek more demanding experiences or to increase the rate at which they utilize trails and areas. A closely correlated effect of increased experience may be a demand for variation, either in terms of the activity or new and different environments. Ski tourers who begin on the local golf course may end up in competitive racing or wilderness treking. Increased specialization or an intensified interest in a narrow segment of an activity is typical of the individual's involvement in any form of recreation. Changes in the behavior of those already participating can bring about significant shifts in demand.

Experience can affect some participants very differently. These individuals will become "saturated" with the opportunities provided by an activity and drop out altogether in order to seek an even more contrasting experience. A similar, but quicker, response can be expected from those who simply discover after a trial period that the activity is not to their liking. The net effect of these countervailing responses is dependent on the inherent appeal and variation within an activity.

When an individual elects to take up an activity he or she is making an investment in dollars, time, energy, and social alliances. These investments will tent to perpetuate involvement. In some instances the social benefits or obligations may become the primary motivation for continuing the activity. The same can be said, of course, for competing alternatives. Many of those who became involved in snowmobiling before they were aware of ski touring will have a difficult time switching to ski touring, even if they perceived the activity itself as more desirable.

The accumulative effect of internal changes may be more important than changes in total numbers of participants. In a rapidly evolving activity, such as ski touring, this effect is probably even more significant. It may be a mistake to predict demand on the basis of current preferences when a future ski touring population will be much more experienced and skilled.

The Role of the Commercial Sector

It is probably safe to assume that there is no perceived human need that someone won't attempt to "capture" in the economic sense. Recreational benefits vary tremendously in their susceptibility to capture. Ski touring, relative to its main rivals snowmobiling and downhill skiing, is more difficult to package. The equipment is relatively less expensive and the activity is not as restricted to specially developed facilities. For these reasons ski touring was largely ignored by the commercial sector during its early years of evolution in the United States. In fact, the downhill ski industry may have deliberately tried to subdue the public's exposure to a competing activity (Fishman, 1978).

Ski touring (running provides a similar parallel) continued to grow because of its inherent appeal. The commercial sector joined the "bandwagon" and has since developed innovative ways to package and sell the ski touring experience. The primary approach has been an effort to convince skiers that they need more refined, and often more expensive, equipment in order to fully enjoy the potentials of the sport. Gadgets also proliferate as any activity becomes popular. Appeals to the fashion conscious are prevalent. Resorts are providing groomed trails and elaborate lodging facilities. Organized tours to exotic environments are being made available.

There is little doubt that the commercial sector has added tremendously to the array of opportunities within the sport of ski touring and thus has helped to perpetuate interest in the activity. The success of these innovations is probably assured by the much broader range of persons now participating in ski touring. Whereas the early "pioneers" often prided themselves in their resourcefulness and spartan demands, the broader spectrum of recent adherents are more likely to include those seeking comfort and convenience. This is not to say that the old hands won't also take advantage of the new opportunities provided!

Rate of Change and Cycles

It is relatively easy to predict the direction of change; somewhat more difficult to predict the ultimate potential; and nearly impossible to predict the rate of change in participation in a recreation activity. Ski touring grew slowly during its initial stages because it lacked a strong commercial impetus. The flow of information was largely dependent on word of mouth, organizations, and magazine articles. Television and billboard exposure was minimal.

Inherent characteristics would indicate a potential for rapid growth once the visibility barrier was overcome. The sport requires a relatively small investment in money and time to learn special skills; therefore a person can quickly become a participant.

For simplicity's sake our discussion has implied a linear, one-way pattern of change. The same mechanisms, and others yet unidentified, may bring about short or long term cycles. For example, an individual may tire of ski touring, drop out temporarily and join again at a later time. When this mechanism affects a large number of persons at the same time we can expect larger cycles in the total number of participants. Even shorter, day to day or minute to minute, cycles are probably operating--although these are less important in a discussion of long term trends. The seasonal cycle brought about by the climatic requirements of ski touring may serve to prolong interest over t long term by forestalling saturation.

Summary of Framework

One is tempted to describe the changes in participation as "phases" in a predictab pattern of change. First, there is a pione phase led by a small cadre of individuals willing to explore and risk disappointment. These people may seek out, or even develop, a form of recreation which fulfills well defined needs. In Stanley Plog's (1974) term these are the "alocentrics," while those wh follow can be labeled "psychocentrics". Se ond, others, with similar motivations, take up the activity as it becomes more generall visible. In the third phase, followers joi when there is an ample demonstration of acceptability and benefits. During the four phase the activity stabilizes when it is generally well known to the total population and there are few changes in the nature of the opportunities available. A fifth phase may or may not occur. This last phase is a decline in participation because of externa factors or simply because the novelty of th experience wears off. Other events may disrupt a long period of stability. For example, a major breakthrough in equipment ma make participation easier or more enjoyable Stynes (1980) and others, have postulated a "product life cycle" concept which implies a predictable decline in participation. It is hazardous to impose a standard pattern o all recreation participation phenomena. Although this sort of description can help organize our thinking, it is no substitute for an understanding of the specific mechanisms at work.

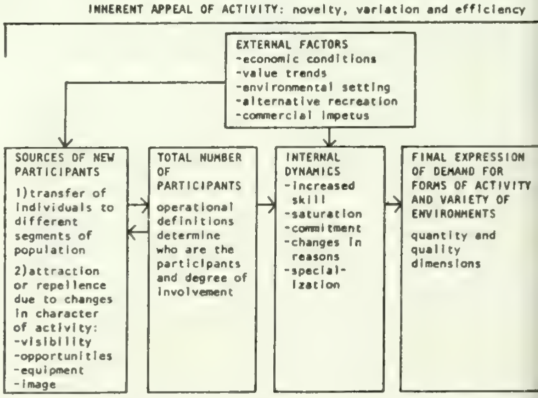

INHERENT APPEAL OF ACTIVITY: novelty, variation and efficiency
EXTERNAL FACTORS
-economic conditions
-value trends
-environmental setting
-alternative recreation
-commercial impetus
SOURCES OF NEW PARTICIPANTS
1)transfer of individuals to different segments of population
2)attraction or repellence due to changes in character of activity:
-visibility
-opportunities
-equipment
-image
TOTAL NUMBER OF PARTICIPANTS
operational definitions determine who are the participants and degree of involvement
INTERNAL DYNAMICS
-increased skill
-saturation
-commitment
-changes in reasons
-specialization
FINAL EXPRESSION OF DEMAND FOR FORMS OF ACTIVITY AND VARIETY OF ENVIRONMENTS
quantity and quality dimensions

Figure 1. A schematic representation of the factors which influence the quantity and quality of participation. Short term and longer cycles may occur within the context of this framework.

Figure 1 provides a graphic summary of the mechanisms and patterns described earlie As is true of any attempt to organize realit it is somewhat arbitrary and simplistic. It does serve the purpose of aiding researchers in their efforts to systematically deal with the complexities of participation dynamics. Modifications and refinements can occur as our knowledge and experience increases.

The ultimate output of any analysis conducted within the context of this framework is a better estimate of the demand for experiences, both the quantity and quality dimensions.

A PARTIAL TEST OF THE FRAMEWORK

Methods

A statewide, random telephone survey of Minnesota residents conducted by the Minnesota Department of Natural Resources in 1978 provided a representative sample of state ski tourers. Anyone over 14 years of age who had "cross-country skied sometime during their life" was included in the sample. Our study utilized a four page questionnaire mailed to the sample. A 75 percent response rate produced a sample of 597 completed questionnaires. The survey instrument solicited four categories of information: 1) patterns of participation; 2) reasons or motivations for participation; 3)environmental preferences; and 4) demographic characteristics. Although the questionnaire was not designed primarily to study the dynamics of participation, one question, "In which season did you first go cross-country skiing?", enables us to examine the changes over time.

For the purposes of this report several variables were cross-tabulated with the year an individual first took up the activity. While this sort of data does not lend itself well to statistical tests it does allow us to look for patterns of change and to speculate on the mechanisms at work.

Two broad questions will be addressed: 1) Are recent adherents motivated differently than those who took up the sport early in its development? and 2) Do more experienced skiers prefer more challenging areas and/or more variation in opportunities?

Changes Over Time in the Characteristics and Motivations of New Adherents

Tables 1 through 6 show some of the characteristics of participants according to the year they first took up the sport. In examining these tables it is critical to remember that the first category contains all of those who had skied prior to the 1972-73 season. This could include some elderly individuals who had skied early in the century but very little since. Given the rapid rate of increase in participation during the past 10 to 12 years the latter probably account for a very small portion of the sample.

Table 1: Level of education and first season of cross-country skiing

	YEARS OF EDUCATION, RELATIVE FREQUENCY (PERCENT)				
First Season	1-8	9-12	13-16	17+	(N) %
prior to 1972-73	(2) 3	(10) 17	(25) 42	(23) 39	(60) 100
1972-73	(1) 2	(9) 22	(17) 42	(14) 34	(41) 100
1973-74	(0) 0	(17) 28	(36) 59	(8) 13	(61) 100
1974-75	(0) 0	(29) 41	(25) 35	(17) 24	(71) 100
1975-76	(1) 1	(29) 31	(41) 43	(24) 25	(95) 100
1976-77	(3) 3	(39) 40	(43) 44	(13) 13	(98) 100
1977-78	(0) 0	(51) 39	(64) 48	(17) 13	(132) 100

The most pronounced changes have ocurred in the level of education and the sex of participants (Tables 1 and 2). College graduates have become a smaller percent of new adherents while the proportion of those with some high school education has increased. This is consistent with West's notion of "status group diffussion". The change can also be accounted for by increased visibility and the role of the media.

Table 2: Sex distribution and first season of cross-country skiing

	RELATIVE FREQUENCY (PERCENT)		
First Season	FEMALES	MALES	(N) %
prior to 1972-73	(25) 42	(35) 58	(60) 100
1972-73	(18) 45	(22) 55	(40) 100
1973-74	(28) 47	(32) 53	(60) 100
1974-75	(47) 66	(23) 34	(70) 100
1975-76	(62) 65	(33) 35	(95) 100
1976-77	(49) 50	(49) 50	(98) 100
1977-78	(86) 64	(48) 36	(134) 100

Females are increasing their involvement in many forms of recreation once considered primarily for men. Changes in the image of ski touring from a very demanding, physical type of sport to a more casual, social pastime with complementary facilities may also have contributed to the increased participation by women.

Changes in age structure (Table 3) are more difficult to interpret. There is an apparent decrease in the percentage of "older" (40-54 and 55+) skiers and an increase in the 25-39 category; although the latter accounts for a large percent of those who took up ski touring prior to 1972. At least some of the change is an artifact of the tabulation itself, i.e., younger persons are less likely to have taken up ski touring at an earlier date.

Table 3: Age distribution of participants and first season of cross-country skiing

First Season	AGE CATEGORIES, RELATIVE FREQUENCY (PERCENT) 15-24	25-39	40-54	55+	(N) %
prior to 1972-73	(4) 7	(26) 45	(14) 24	(14) 24	(58) 100
1972-73	(17) 42	(11) 28	(10) 25	(2) 5	(40) 100
1973-74	(27) 45	(17) 28	(13) 22	(3) 5	(60) 100
1974-75	(23) 34	(31) 45	(12) 18	(2) 3	(68) 100
1975-76	(40) 43	(37) 40	(13) 14	(3) 3	(93) 100
1976-77	(39) 41	(41) 43	(12) 12	(4) 4	(96) 100
1977-78	(56) 43	(52) 40	(19) 15	(3) 2	(132) 100

Responses to the question of residency (Table 4) are also difficult to analyze. We can't be sure what an individual thought was meant by "rural area," nor can we be certain whether a suburbanite would consider himself or herself a resident of a suburb or the Twin Cities Metro Area. It is probably safest to lump both ends of the spectrum for the basis of comparison. Still, at least a few of those who think of their residence as "rural" probably live on the fringe of the metro area and have a more urban lifestyle. This interpretation may help to reconcile our data with the results a statewide Department of Natural Resources survey (1979) conducted in 1978 which provided an estimate of the number of persons who had cross-country skied during that season. Sixty-three percent of the skiers were from the seven-county metro area.

Table 4: Distribution of residency and first season of cross-country skiing

First Season	DISTRIBUTION OF RESIDENCY, RELATIVE FREQUENCY (PERCENT) over 250,000	25,000-250,000	10,000-25,000	less than 10,000	rural	(N) %
prior to 1972-73	(10) 17	(8) 13	(10) 17	(14) 24	(17) 29	(59) 100
1972-73	(5) 12	(9) 22	(8) 19+	(8) 19+	(11) 27	(41) 100
1973-74	(12) 20	(12) 20	(9) 15	(11) 18	(16) 27	(61) 100
1974-75	(11) 15	(14) 20	(17) 24	(10) 14	(19) 27	(71) 100
1975-76	(16) 17	(14) 14	(19) 20	(23) 24	(24) 25	(96) 100
1976-77	(16) 16	(23) 24	(12) 12	(21) 22	(25) 26	(97) 100
1977-78	(22) 17	(21) 16	(26) 20	(23) 17	(39) 30	(131) 100

Residency is an important factor is that it allows us to monitor the diffusion of ski touring from the urban areas (where the current resurgence has been most pronounced) to the more rural areas. The relative stability in our data may indicate that differences in visibility weren't as great as suspected. Another possibility is that snowmobiling has had a secure hold on the rural population and individuals are reluctant to give up an investment with known benefits for a (to them) new activity.

In speculating on the growth of an activity it may be valuable to know to what extent participants in similar activities are providing a reservior of potential adherents. Table 5 shows the extent to which cross-country skiers have participated in other forms of winter recreation.

Table 5: Participation in other winter activities and first season of cross-country skiing

First Season	DISTRIBUTION OF PARTICIPATION IN OTHER WINTER ACTIVITIES snow-shoeing	downhill skiing	snow-mobiling	winter camping	no other	(N) %
prior to 1972-73	(30) 50	(36) 60	(38) 63	(22) 37	(8) 13	(60)
1972-73	(20) 49	(26) 63	(25) 61	(12) 29	(2) 5	(41)
1973-74	(30) 49	(43) 70	(44) 72	(16) 26	(4) 6	(61)
1974-75	(30) 42	(46) 65	(51) 72	(14) 20	(6) 8	(71)
1975-76	(31) 33	(71) 75	(67) 70	(18) 19	(4) 4	(95)
1976-77	(34) 35	(65) 66	(73) 74	(18) 18	(7) 7	(98)
1977-78	(36) 27	(77) 58	(99) 74	(26) 20	(14) 10	(133)

Earlier participants were more likely to have engaged in snowshoeing. Changes in relative visibility may explain some of this trend, i.e., snowshoeing probably had nearly the same level of visibility during the early stages of the growth of ski touring. The trend is also consistent with the idea that earlier adherents were more likely to be "pioneers" who were exploring a number of different forms of recreation.

Downhill skiing is a natural complement to cross-country skiing. On the other hand it is common for individuals to state that they have switched to touring because of increased costs, crowding or concern for possible injuries. Our data is inconclusive in that it is also possible for a person to begin as a cross-country skier and switch to downhill as they gain confidence and seek a wider range of experiences.

There has been a great deal of speculation about the relationship between snowmobiling and cross-country skiing. Our data show a slight increase in the number of new skiers who have participated in snowmobiling. We can expect that as the number of ski tourers increase it will draw upon a large existing population of snowmobilers. The gradual decline in snowmobiling since 1976 (as indicated by the registration of machines) inforces the probability that some snowmolers are turning to ski touring as an ternative form of winter recreation; it so tends to reduce the probability of an ternative explanation, i.e., that a greater rcentage of new skiers are taking up snowbiling simultaneously.

Winter camping is more complementary than mpetitive in its relation to ski touring d appears to be related to experience. It ems reasonable to assume (and the data lend me support) that a cross-country skier needs acquire a certain level of skill and conience in the winter environment before he she becomes involved in winter camping.

We have inferred something of the motitions of cross-country skiers from behavioral tterns and demographic characteristics. ble 6 provides a more direct measure of the asons skiers took up the sport. The respons were given to an open ended question and re than one reason may have been offered.

ble 6: Original reason participants thought they might enjoy cross-country skiing and first season of cross-country skiing

RELATIVE FREQUENCY (PERCENT) OF REASONS GIVEN

rst ason	exercise	fresh air	outdoors	scenery	peace/ tranquility	friends liked	with friends family	fun	easy	inexpensive	liked downhill	(N) %
ior to 72-73	(41) 67	(4) 7	(18) 30	(3) 5	(6) 10	(8) 13	(3) 5	(4) 7	(2) 3	(5) 8	(3) 5	(61)
72-73	(21) 51	(2) 5	(11) 27	(6) 15	(4) 10	(4) 10	(1) 2	(3) 7	(1) 2	(2) 5	(3) 7	(41)
73-74	(20) 33	(2) 3	(25) 41	(5) 8	(6) 10	(5) 8	(4) 7	(3) 5	(3) 5	(2) 3	(7) 12	(61)
74-75	(22) 31	(1) 1	(25) 35	(7) 10	(5) 7	(9) 13	(0) 0	(2) 3	(5) 7	(5) 7	(7) 10	(71)
75-76	(22) 23	(2) 2	(34) 35	(5) 5	(12) 12	(11) 11	(9) 9	(3) 3	(6) 6	(6) 6	(9) 9	(96)
76-77	(41) 41	(10) 10	(30) 30	(7) 7	(8) 8	(16) 16	(5) 5	(11) 11	(5) 5	(7) 7	(6) 6	(99)
77-78	(43) 32	(8) 6	(45) 34	(12) 9	(13) 10	(27) 20	(8) 6	(8) 6	(7) 5	(11) 8	(8) 6	(134)

Exercise and access to the outdoor envi-ment have always been important motivations. importance of exercise appears to be some-t less than during the early years. The ly association may have resulted from the inant image of cross-country skiing as a sically demanding activity.

Our data show little change during the t five years in the importance of the tdoors" as an attractor to cross-country ing. This may reflect a stability in our iety's attitudes toward the natural envi-ment and the need to complement daily tines associated with the urban setting.

The influence of friends and relatives ws an interesting pattern; a slight decline m its importance prior to 1972 and then an rease during the past few years. The early importance of peer influence may be an indication of the type of visibility cross-country skiing had at the time. There was little media exposure and most persons heard about ski touring from people they knew. Currently, given the high level of visibility ski touring is experiencing, peer influence becomes more of a factor as participants are drawn from the marginally interested population and the "psychocentrics" or followers.

The Effect of Experience on the Individual's Demand for Opportunities

Our data is not ideally suited to test this relationship. Nevertheless it can provide some insights.

There is a clear relationship between years of experience and self-rated skill level as shown in Table 7. We might expect a similar correlation with the demand for more challenging types of opportunities. Table 8 presents relative preferences for specific environmental characteristics, some of which may indicate a desire for more demanding opportunities.

Table 7: Distribution of self-rated skill level and first season of cross-country skiing

SELF-RATED SKILL LEVEL, RELATIVE FREQUENCY (PERCENT)

First Season	novice	advanced novice	inter-mediate	advanced inter-mediate	advanced	expert	(N) %
prior to 1972-73	(9) 15	(11) 19	(18) 31	(14) 24	(5) 9	(1) 2	(58) 100
1972-73	(9) 22	(7) 17	(14) 35	(9) 22	(1) 2	(1) 2	(40) 100
1973-74	(14) 23	(11) 18	(23) 38	(9) 15	(4) 6	(0) 0	(61) 100
1974-75	(19) 27	(20) 28	(21) 30	(10) 14	(1) 1	(0) 0	(71) 100
1975-76	(18) 19	(37) 39	(27) 28	(10) 11	(3) 3	(0) 0	(95) 100
1976-77	(38) 39	(29) 29	(23) 23	(7) 7	(2) 2	(0) 0	(99) 100
1977-78	(71) 53	(35) 26	(22) 16	(3) 2	(1) 1	(2) 2	(134) 100

There appears to be a slight tendency for the newer skiers to have a higher preference for groomed, well marked trails. They are also more likely to find longer trails and remote areas undesirable. On the other hand they don't appear to be too much different in their attitudes toward breaking trail (i.e., making tracks in new, unpacked snow) or trails requiring a high level of skill. Perception of difficulty is, of course, quite subjective. We might expect some consistency with self-rated skill level however.

Our data is inconclusive on the question of how experience affects the desire for challenging opportunities. A number of other factors are probably involved. For example, groomed, well marked trails are much more prevalent now than in the past; thus newer skiers have been conditioned to accept these characteristics as "standard" and a dominant aspect of their image of cross-country skiing.

Table 8: Preferences for selected environmental characteristics
and first season of cross-country skiing

FREQUENCY DISTRIBUTION (PERCENT) OF PREFERENCES
FOR ENVIRONMENTAL CHARACTERISTICS

First Season	groomed trails	unbroken trails	signs	connecting trails	25 mile trails	remote, hard to reach	high skill required	encounter nobody
prior to 1972-73 (N=61)								
undesirable	9	22	0	7	29	27	36	11
neutral	42	25	33	44	55	40	34	39
desirable	49	53	67	49	16	33	30	50
1972-73 (N=41)								
undesirable	15	30	5	12	34	32	44	20
neutral	27	20	18	34	37	36	39	34
desirable	58	50	77	54	29	32	17	46
1973-74 (N=61)								
undesirable	6	17	10	17	27	25	22	20
neutral	35	37	37	41	43	34	52	49
desirable	59	46	53	42	30	41	26	31
1974-75 (N=71)								
undesirable	7	29	7	13	46	43	41	13
neutral	27	20	29	46	37	30	39	49
desirable	66	51	64	41	17	27	20	38
1975-76 (N=96)								
undesirable	8	24	6	11	39	40	39	18
neutral	30	30	23	44	40	26	37	28
desirable	62	46	71	45	21	34	24	54
1976-77 (N=99)								
undesirable	4	17	6	11	32	41	37	24
neutral	39	41	19	48	51	33	33	54
desirable	57	42	75	41	17	26	30	22
1977-78 (N=134)								
undesirable	7	19	5	12	32	45	42	22
neutral	24	39	20	44	45	29	43	51
desirable	69	42	75	44	23	26	15	27

Those seeking greater challenges may be attracted to the increasingly popular "citizens tour races". These are all comers events where everyone competes against the clock or simply attempt to go the distance. The growth in the number of scheduled events and the number of entrants is ample evidence for the appeal of this kind of challenge. This trend is not reflected in the items contained in our survey.

The best approach to determining changes which have occurred within individual participants may be by means of in-depth interviews. This process would document their life history within the activity and the linkages between changes in attitudes and behavior. For the future we may be able to establish "panel" type studies which follow the development of individual participation. In any case it is difficult to separate internal, self-initiated changes brought about by actual participation from those imposed by changes in the image of the activity as a whole.

SOME ADDITIONAL COMMENTS AND CONCLUSIONS

It should be quite obvious that there i no substitute for a thorough familiarity wit the activity(s) under consideration. An understanding of participation dynamics does not lend itself to simplistic formuli or fit a standardized pattern of change. Survey instruments can be designed to answer specifi questions within a comprehensive framework. Valid inferences are impossible if the researcher is not aware of the numerous variables which cannot be incorporated into the questionnaire or interview schedule.

Often we can supplement our internal analysis with a comparison to other times an places. Norway, a country similar in size, population, and climate to Minnesota, has a well established tradition of cross-country skiing. The history of skiing in Norway pro vides some hints as to its potential in the United States. A 1970 analysis of outdoor recreation, sports, and exercise in Norway showed that during that (1969-70) season 52 percent of the population took shorter ski trips, 29 percent took daylong trips in forests and fields and 28 percent took daylong trips in the mountains (these are not exclusive categories). With these rates as a benchmark we can proceed to qualify for th conditions in Minnesota. Minnesota does not have the traditions of Norway. Minnesota does have a well established competitor for the individual's attention, namely snowmobiling. A lot may depend on how actively public agencies develop opportunities and promote the sport. In Norway the promotion of physically demanding forms of recreation is an important part of public policy. Motorized activities, such as snowmobiling, are subject to more restrictions than in the United States.

Prediction is always a risky undertakin -- there are many "ifs" in the equation. A fundamental question is how actively we want to become involved in creating the condition which effect change. As risky as it is, someone must take the responsibility to make a judgement.

REFERENCES

Ballman, G., Merriam, L.C., and Knopp, T.B. 1979. Interim Response Summary for the 1978 Minnesota Cross-Country Skiing Study. College of Forestry, University of Minnesota, St. Paul, Minnesota.

Christy, F.T. 1970. Elements of mass demand for outdoor recreation resources. In: Elements of Outdoor Recreation Planning edited by B.L. Driver. Ann Arbor, Michigan: University Microfilms.

Dalton, M.J. 1979. Minnesota Cross-Country

Skiers, Report No. 2321. Minnesota Department of Natural Resources, Bureau of Comprehensive Planning and Programming, St. Paul, Minnesota.

Driver, B.L. and Brown, P.J. 1975. A social-psychological definition of recreation demand, with implications for recreation resource planning. Appendix A in Assessing Demand for Outdoor Recreation. Washington, D.C. National Academy of Science. Reprinted by the Bureau of Outdoor Recreation, U.S.D.I.

Driver, B.L. 1977. Item pool for scales designed to quantify the psychological outcomes desired and expected from recreation participation. U.S.F.S. Rocky Mountain Forest and Range Experiment Station.

Fishman, J.A. 1978. A maturing sport faces growing pains. New York Time, December 31, 1978.

Knopp, T.B. 1972. Environmental determinants of recreation behavior. Journal of Leisure Research 4(2):129-138.

Meyersohn, R. and Katz, E. 1958. Notes on the natural history of fads. In: Mass Leisure, edited by Eric Larrabee and Rolf Meyersohn. Glencoe, Illinois: The Free Press.

Plog, S.C. 1974. Why destination areas rise and fall in popularity. The Cornell Hotel and Restaurant Administration Quarterly. Vol. 14: No. 4.

Statistisk Sentralbyro (Central Bureau of Statistics of Norway). 1975. Frilufstliv, Idrett og Mosjon (outdoor Recreation, Sprot and Exercise). Oslo, Norway.

Stynes, D.J. 1980. Interrelationships among three outdoor recreational sports. North American Symposium on Dispersed Winter Recreation, 27-29 February 1980. University of Minnesota, Office of Special Programs, St. Paul, Minnesota.

Tinsley, H.E.A., Barrett, T.C., and Koss, R.A. 1977. Leisure activities and need satifaction. Journal of Leisure Research 9(2):110-120.

West, P.C. 1977. A status group dynamics approach to predicting participation rates in regional recreation demand studies. Land Economics 53(2):196-211.

TRENDS IN THE TEMPORAL DISTRIBUTION OF PARK USE[1]

Robert E. Manning and Paula L. Cormier[2]

The purpose of this paper is to examine trends in the temporal distribution of park use. Plots of daily attendance data trace changes in temporal use distributions over time. A use concentration index quantifies and reduces to a single numerical indicator the degree of unevenness of recreation attendance data. The percent of total annual use accounted for by selected time periods is also examined.

INTRODUCTION

Trends in outdoor recreation are normally nitored on some aggregated level, usually on annual basis. Participation in hunting and shing, for example, is commonly monitored rough yearly license sales, while snowmobiling d trailbiking activity is measured by annual gistrations, and use of parks, forests, and mpgrounds is most often reported in visits or sitor days per year. Monitoring of recreaon activity at this aggregated level is highly eful in identifying long-term trends in participation and the relative popularity of various tdoor recreation activities, but disregards e manner in which recreation activity is stributed over the reporting period. Paraxically, it is the typically uneven manner in ich recreation participation is distributed er time which presents one of the most persive problems in outdoor recreation management.

In the classic case, park and recreation stes open for "the season" on Memorial Day wekend and close on Labor Day. The result is afull year's use condensed into little more tan three months. Even within this "season" u may be skewed toward weekends and holidays rsulting in a marked "peaking" phenomenon. Tere are a number of significant problems asociated with this typical use distribution ptern. First, to satisfy demand, recreation filities and services must be developed at a sle to meet peak loads. These facilities and svices may go largely unused at most other times, resulting in inefficient resource use. Second, the social carrying capacity of recreation areas may be unnecessarily exceeded by peak loads through crowding and increased potential for conflicting uses. Third, there is preliminary evidence that even ecological carrying capacity may be unduly taxed by excessively concentrated visitor use (Lime 1972). Finally, periodic peaking of recreation use presents substantial administrative problems, particularly with respect to personnel scheduling.

While this peaking problem in outdoor recreation has been recognized for some time (Clawson and Knetsch 1966), there have been few efforts aimed at its systematic study. This is apparently due to the prevailing attitude among recreation planners, managers, and researchers that the temporal patterns of outdoor recreation use are determined by factors which are viewed as largely uncontrollable. Such factors include weather and societal work and leisure patterns. It is the purpose of this paper to report on a cooperative study recently undertaken by the University of Vermont and the Northeastern Forest Experiment Station which seeks to examine trends in the temporal distribution of park use in order to more fully understand this problem. The ultimate objective of this study is to suggest methods by which the use of park and recreation areas may be more evenly distributed over time.

METHODS AND ANALYSIS

The first phase of this study was to develop techniques to quantify the temporal distribution of selected outdoor recreation activities. Development of appropriate measurement techniques is needed to facilitate trend analysis. Three approaches to measurement have been developed to date. The remainder of this section of the paper describes these three measurement techniques, and their application to two data series. One data series traces daily attendance at forty Vermont State Park campgrounds from 1977 to 1979, while the other traces daily campground occupancy at one New Hampshire State Park from 1971 to 1977.

---

[1] Paper presented at the National Outdoor Rreation Trends Symposium, Durham, NH, April 2-23, 1980.

[2] Robert E. Manning is Assistant Professor, Rreation Management Program, University of Vmont; Paula Cormier is Mathematical Statistin, USDA Forest Service, Durham, NH.

Plotting of Attendance Data

A series of computer programs were developed which graphically plot occupancy data at park and recreation areas. In Figure 1, use of four Vermont State Park campgrounds are plotted as a percentage of peak use by day. The significance of these plots is that they illustrate the peaking phenomenon in a clear and often dramatic way, and indicate visually where use redistribution efforts are needed.

Also of significance is the variety of use distributions represented in Figure 1. Daily plots for all Vermont State Park campgrounds in 1977 could be grouped into the four general types illustrated in Figure 1. Elmore State Park represents a moderately uneven distribution of use, showing consistent weekend and holiday peaking while weekdays during July and August average approximately 50 percent of maximum attendance. Townshend State Park illustrates extreme weekend peaking, while Button Bay State Park illustrates consistent holiday peaking. Lake St. Catherine State Park illustrates a relatively even distribution of use, with campground occupancy remaining above 80 percent through the months of July and August.

This variety of use distributions suggests that the peaking problem may be subject to remedy to some degree through appropriate planning and management. It is likely that some characteristics of either the recreation site or the attendant user groups result in this diversity of attendance patterns. If these characteristics can be identified, then they can be incorporated into planning and management decisions aimed at evening out the distribution of recreation use over time.

Finally, plots of daily attendance data can be used to trace changes in temporal use distributions over time. Figure 2, for example, illustrates a change toward more even distribution of use at Button Bay State Park from 1978 to 1979.

Use Concentration Index

While plots of daily attendance data are a useful graphic measure of recreation use distribution patterns, a more quantitative measure is also needed. For this purpose, the concept of a use concentration index was adopted. The use concentration index was first introduced by Stankey et al. (1976) and applied in a spatial dimension to wilderness recreation use patterns. The purpose of the index was to measure the extent to which wilderness trail systems are used in an uneven fashion; that is, some trail segments are used heavily while other trail segments remain relatively unused. By substitututing the days of a recreation season for miles of trail, the use concentration index ca applied to the temporal dimension as well.

The advantage of the use concentration in is that it quantifies and reduces to a single numerical indicator the degree of unevenness o recreation attendance data. Using data from Elmore State Park (Figure 3), the cumulative percent of use of the campground is graphed by the cumulative percent of days in the season. The days of the season are ranked and graphed in descending order of use, and use is accumulated starting with the day most used. The 45 degree diagonal represents an even distributio of use (e.g. 50 percent of all days account fo 50 percent of all use), while the curve plots the actual distribution of use (e.g. 50 percen of all days account for nearly 80 percent of a use). The use concentration index is based on the area between the curve and the 45-degree diagonal as a proportion of the total area abo the 45-degree diagonal. The index may take values from 0 (perfectly even distribution) to 1 (perfectly uneven distribution). In the gra for Elmore State Park, the shaded area between the 45-degree diagonal and the curve represent 35 percent of the total area above the diagona Therefore, the use concentration index equals

As with the daily plots of attendance, a series of computer programs were prepared to draft and calculate the use concentration inde When applied to both data series, use concentr tion index values ranged from .12 to .45. Thi range of values again demonstrates, as with th daily plots of attendance, considerable divers in the evenness of use distributions among par

Index values provide a convenient way to monitor trends in the temporal distribution of recreation use. Figure 4, for example, traces changes in the use concentration index for inland and waterfront campsites at Pawtuckaway State Park, New Hampshire, from 1971 to 1977. One might have hypothesized that recent gasoli prices and supplies would encourage fewer camp trips, but of longer duration, and that this would contribute to more evenly distributed recreation use. Figure 4 indicates that this i not the case, however, at least for Pawtuckaway State Park, and that, in fact, the trend is toward more unevenly distributed use. These results might be explained by speculating that higher gasoline costs and shortages are eliminating some groups of recreationists from the camping market, and the most likely group to be eliminated is those who must travel greater distances to the park. Since it is also the group that is most likely to stay longer (throu the mid-week) at the park, their absence from t park is likely to contribute toward more marked weekend peaking.

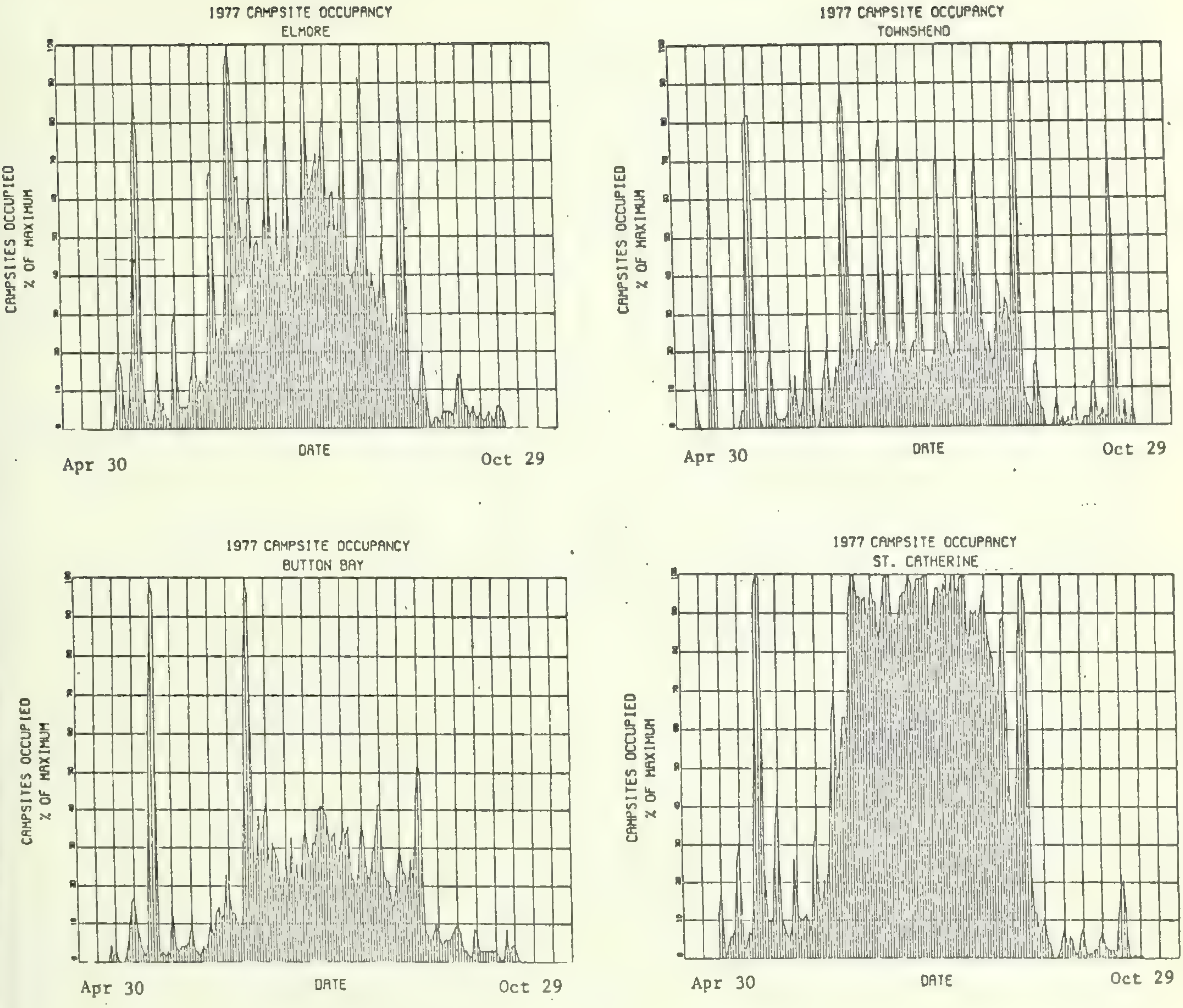


FIGURE 1.--Campsites occupied (percent of maximum) by day for four Vermont State Parks in 1977.

FIGURE 2.--Campsites occupied (percent of maximum) by day for Button Bay State Park (Vermont) in 1978 and 1979.

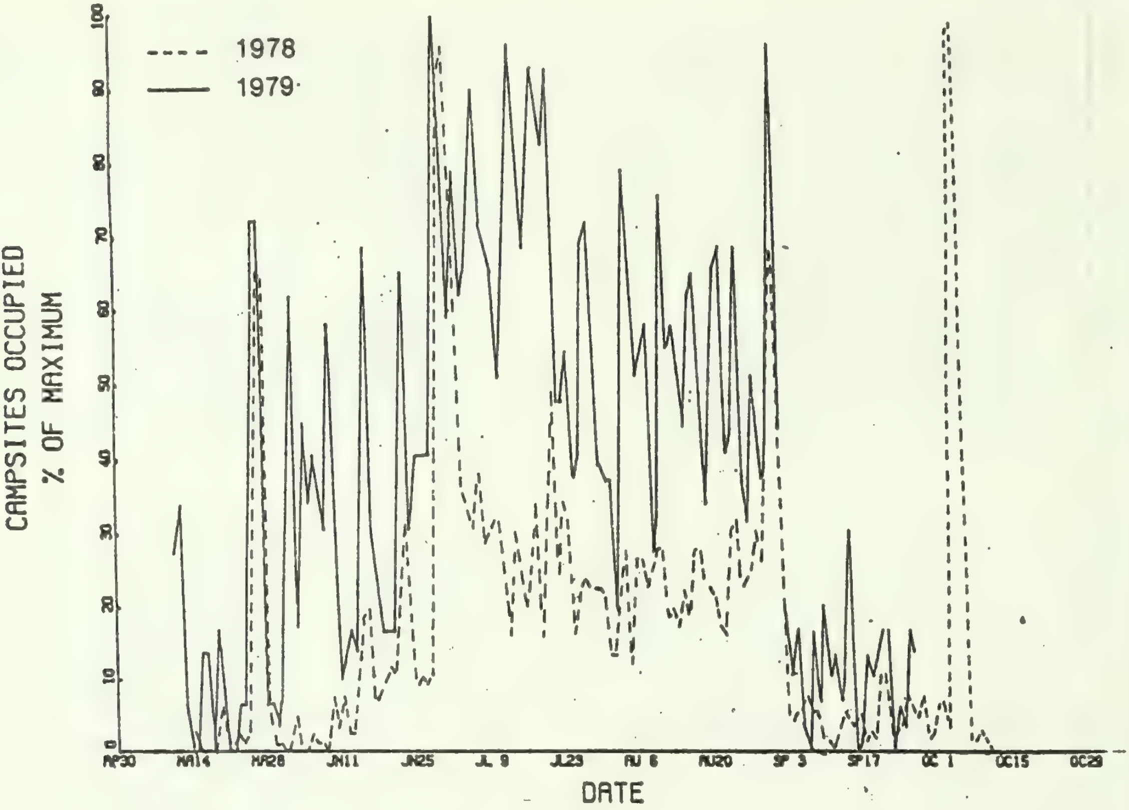
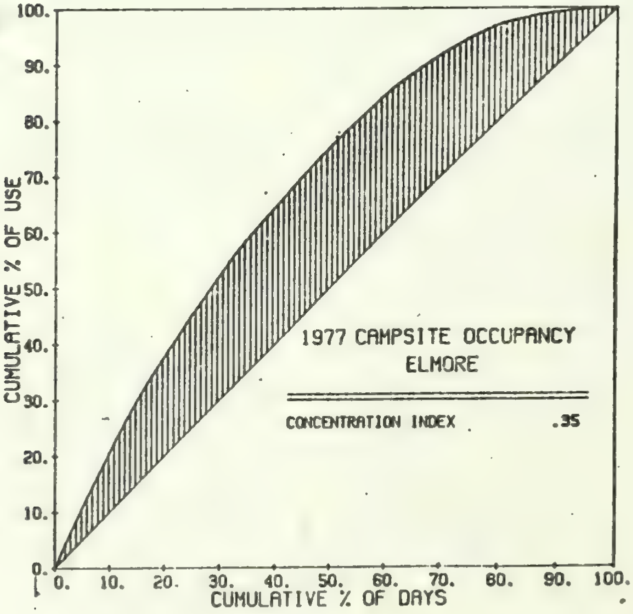
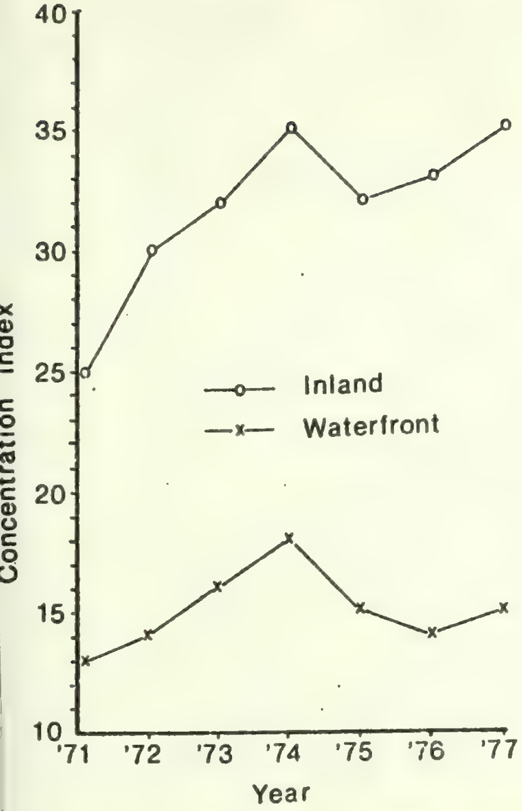


FIGURE 3.--Use concentration index for Elmore State Park (Vermont) in 1977.





IGURE 4.--Trends in use concentration index for inland and waterfront campsites for Pawtuckaway State Park (New Hampshire) from 1971 through 1977.

The use concentration index also has con-
erable potential in contributing to an under-
nding of why some parks have more even dis-
bution of use than others. When the index
used as a dependent variable in regression
lysis, a variety of park characteristics
be examined as independent variables and
tistically tested as to their relationship
h use distribution patterns. Examples of
h park characteristics which might be hy-
hesized as explaining some of the variation
use concentration index values include dis-
ce from population centers, number of camp-
es, size of park, type and number of recrea-
activities, and miles of shoreline.

ent of Use

A third measure of the temporal distribu-
of recreation use involves calculation of
percent of total annual use accounted for
selected time periods. For example, the
ent of total use accounted for by each day
he week provides a measure of how evenly
eation use is distributed over the average
. The bar graph in Figure 5 illustrates
average distribution of use over the days
he week for Button Bay State Park in 1977.
unevenness of the distribution is readily
apparent.

Such percentages may also be monitored over time to determine if weekly recreation use patterns are becoming more or less evenly distributed. Figure 6 indicates a trend toward more even distribution of use over the days of the week for Button Bay State Park when examined from 1977 to to 1979. Tuesday, Wednesday, and Thursday account for relatively larger percentages of total annual use, while Friday, Saturday, and Sunday account for declining percentages of total use.

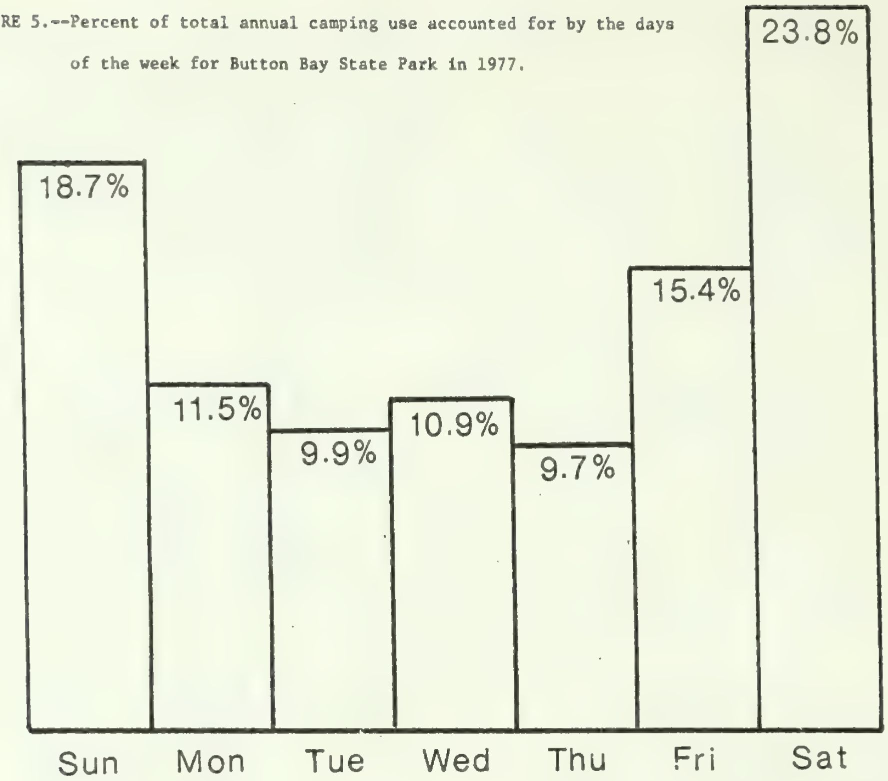
A similar graph was prepared for Pawtuckaway State Park (inland campsites) to trace trends in weekly use distributions from 1971 through 1977 (Figure 7). While trends are not as readily apparent in this case, there appears to be a tendency toward Friday and Saturday accounting for relatively larger percentages of total annual use, and thus for weekly use patterns becoming more unevenly distributed. It is interesting to note in Figure 7 the dramatic changes in the percent of use accounted for by Friday and Sunday in 1974. One might hypothesize that such a change might have been caused by Sunday closings of gasoline stations, encouraging weekend park users to camp Saturday and Sunday nights rather than Friday and Saturday nights in order to purchase gasoline for the return trip home on Monday mornings when gasoline stations reopened.

The percent of total annual use accounted for by seasons might also be an important measure of temporal recreation use patterns. The percent of use accounted for by the summer (Memorial Day weekend to Labor Day), spring (prior to Memorial Day weekend), and fall (after Labor Day) seasons for Elmore State Park from 1977 to 1979 is shown in Figure 8. While the summer season accounts for the largest percentage of total campground use, this percentage appears to be declining with a trend toward an increasing percentage of use during the fall season. Trends toward increasing percentages of total annual use for the fall and spring seasons have also been found for Michigan State Park campgrounds by Stynes and Rottmann (1979).

FURTHER RESEARCH

The three techniques described above -- plots of daily attendance data, the use concentration index, and calculation of the percent of use accounted for by selected time periods -- have proven useful in measuring the temporal distribution of recreation and tracing trends in these distributions over time. These measurement techniques will be applied more widely as additional data series become available so that we might investigate a wide variety of recreation sites and activities, and continue to monitor trends in the future.

FIGURE 5.--Percent of total annual camping use accounted for by the days of the week for Button Bay State Park in 1977.



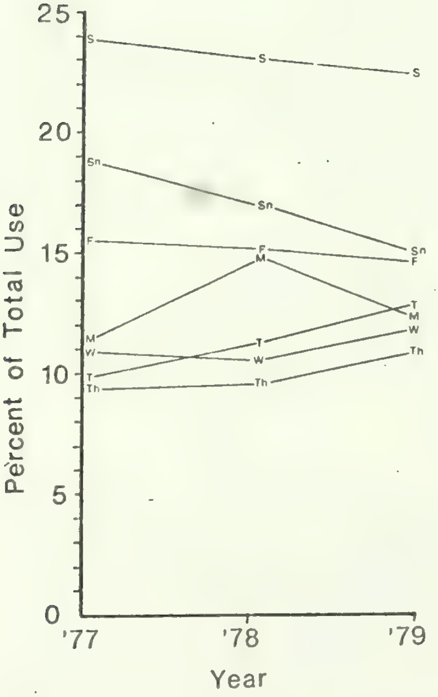


FIGURE 6.--Trends in the percent of total annual camping use accounted for by the days of the week for Button Bay State Park from 1977 through 1979.

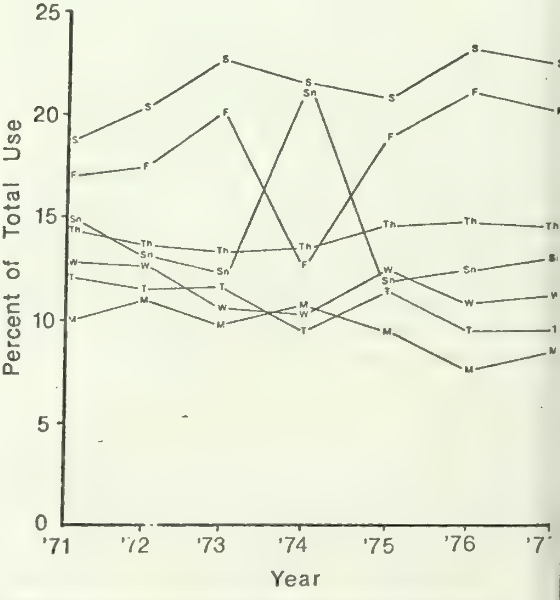


FIGURE 7.--Trends in the percent of total annual camping use accounted for by the days of the week for inland campsites of Pawtuckaway State Park from 1971 through 1979.

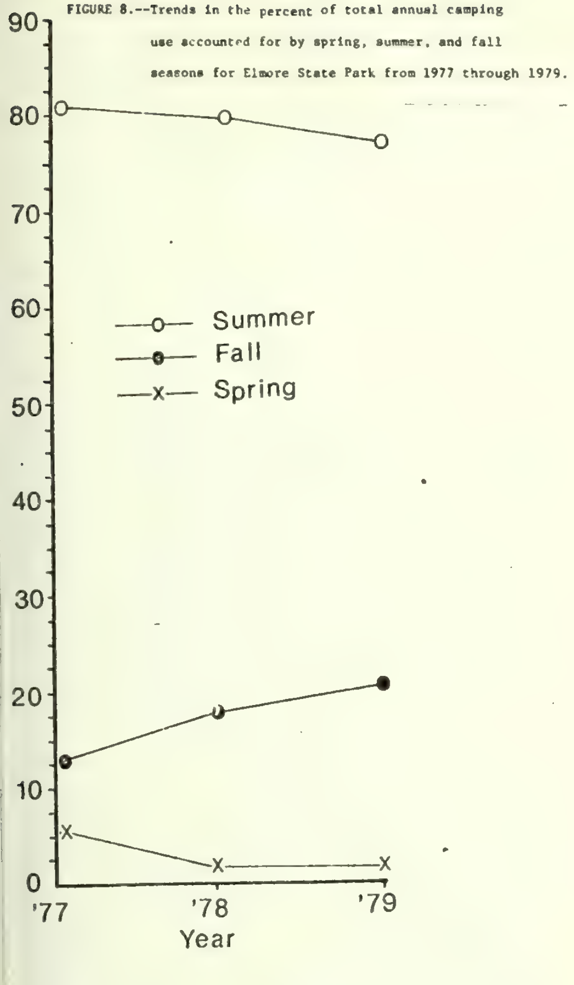


FIGURE 8.--Trends in the percent of total annual camping use accounted for by spring, summer, and fall seasons for Elmore State Park from 1977 through 1979.

A second phase of research will be aimed explaining why there are substantial differ- es in the evenness of use distributions ng park sites. As noted earlier, the use centration index provides a convenient de- dent variable from which regression analysis help explain the relationship between park characteristics and recreation use distri- ions.

A third phase of research will involve an lysis of recreation users to explore and luate selected management and marketing ategies designed to redistribute recreation more evenly. A random selection of peak off-peak users will be interviewed at eation sites and a comparative analysis will lone to identify target markets for redistri- on efforts. Both peak and off-peak users be analyzed with regard to socioeconomic acteristics, stage in family life cycle, and leisure patterns, recreation motiva- s and satisfactions, and response to osed management/marketing efforts such as erential fees, changes in site development l, recreation activities and facilities offered, and dissemination of information on conditions of crowding.

It is hoped that these three phases of research will lead ultimately to a series of suggested recreation planning, management, and marketing guidelines that might be used to reduce the peaking phenomenon in outdoor recreation and result in more even distribution patterns.

LITERATURE CITED

Clawson, Marion and Jack Knetsch 1966. Economics of outdoor recreation. Johns Hopkins University Press: Baltimore.

Lime, David W. 1972. Large groups in the boundary waters canoe area--their numbers, characteristics, and impact. USDA For. Serv. Res. Note NC-142.

Stankey, George H., Robert C. Lucas, and David W. Lime 1976. Crowding in parks and wilderness. Design and Environment. 7(3):38-41.

Stynes, Daniel J., and Kathryn M. Rottman 1979. Trends in seasonality of Michigan state park use. Paper presented at the National Recreation and Park Association Congress, New Orleans, Louisiana.

NETWORK ANALYSIS: A NEW TOOL FOR RESOURCE MANAGERS[1]

Dr. Ruth H. Allen
Assistant Professor
Environmental Systems Management
Center for Technology and Administration
College of Public and International Affairs
The American University
Washington, D.C.

Resource managers manipulate ecosystems or direct or indirect human uses. Examples f relatively well studied resource management ssues include familiar biological products uch as: forests, ranges, fish and wildlife; r physical products such as air, water and oil. Until very recently, urban environments eceived much less scholarly attention. Howver, as Spurr (1969) notes "principles of cosystem management apply to wilderness and o urban environments".

Within urban environments, it is people, nd particularly children who are worthy of ew scholarly attention. After all, why other with long-term resource management, f we ignore the reality of life for today's rban children. They will inherit what ever uture resources today's resource managers eave behind. The discussion of network anlysis presented here is part of a larger tudy of nature and urban children, Allen 1977).

WHAT IS NETWORK ANALYSIS?

Network analysis is a new technique to ncover and map information and communication inks between two or more people using a paricular natural resource. Older forms of etwork analysis trace inanimate linkages, or example, telephone wires, sewer pipes and ransportation corridors. Other human network nalyses are to uncover friendship networks, oreno (1960), political coalitions, Boissevain nd Mitchell (1973) community elites, Laumann nd Pappi (1976), or urban families, Bott 1977) and Gans (1962).

For this study, the network analysis is ased on measured personal associations of rban children, eight to thirteen years of age. All three hundred sixty three children were located outdoors in close proximity to each other while using natural land resources within organized nature recreation, and environmental education programs. All programs serve children from metropolitan, New York, New Jersey and Connecticut. Ordinary, working class urban children, who actually use selected forest environments (parks, camps, nature centers or urban wildlands) are the focus of this study because they have large, accessible social networks. They are also numerous; therefore there are many more children to be served by a decreasing resource base. Moreover, interrelated issues of equity and resource scarcity put added burdens on resource managers and the tools and techniques of resource management.

HOW DOES NETWORK ANALYSIS WORK HERE?

I started this study with a curiosity about the commonplace event of collecting large groups of urban reared children, and moving them to a park, nature center, camp or wildlands for the summer. These events have gone on for a variety of altruistic and youth management objectives for more than one hundred years starting with the newspaper fresh air funds and settlement house outings of Jane Addams.

This study used a series of forested sites with youth outdoor programs to study the role of nature in the lives of urban children. In the study, urban children, were observed over four summers and interviewed on location.

One component of the interview schedule was a sociogram. Respondants were asked to identify companions they would choose for a hike in the woods as an index of the type of association. They are also asked to classify their choices as: relatives, neighbors, school friends or just camp/program friends.

What was different about this study was

---

[1] Paper presented at the National Outdoor ecreation Trends Symposium, Durham, NH, April -23, 1980.

that in addition to mapping the networks of reported associations, and classifying associates as to social distance a simple, unobtrusive way was devised to index the duration of the reported associations. This was done by superimposing the results of a content analysis of attendance records on to the sociograms previously classified according to kinship or associated more distant social links. Return rates were established by checking attendance lists for two consecutive years, to see who reappeared the second year.

It is estimated from the rate of other errors in attendance records that there was not more than a 2% error, since careful attendance checks are required for safety and funding reasons. However, occasionally in crowded urban day type programs a child not on the attendance list, but who knows the system from a previous year will sneak on a bus "going to the beach" or some other swimming hole.

There are at least three stages in any network analysis. Stage one is the network identification process - in this case, I selected youth outdoor programs of various sizes and types. All programs have similar goals, objectives, clients and environmental resources. Given the nature of the urban children, there are likely to be pre-existing networks worthy of analysis.

Stage two involves mapping identified networks. In this instance desk-top and computerized matrix methods were combined to show structural and functional relationships within existing social networks. Three important dimensions of stage two are keeping track of several hundred subjects, identifying returnees and cataloging pre-existing kinship, friendship, neighborhood and school groups.

Stage three is to understand the results of the network analysis. Here the key insights are derived from the comparison of a range of program types. One surprising finding is the extent of pre-existing networks embedded in these outdoor experiences. This is surprising because program managers act as if all users are new to each other and to the natural system resources.

A. Causes of Bonding

All groups change with time. Returnees slow the rate of change by adding stability and consistency to camp life. Network analysis aims to show why camp groups are cohesive and how group cohesion develops with the life history of individuals. The extent and type of pre-existing groups in camp include: kinship, neighborhood, and friendship groups which contribute to group cohesion and high return rates. Camp programs for urban children mimic the life in small, intimate, rural communities during the last century.

The concept of social networks requries an explanation before a presentation of the findings. Networks are private and more or less permanent structures which bind individuals in complex lines of transportation and communication. Moreno (1960) likened social networks to a "container, a bed which carries and mingles its currents, however different their goals may be". Social networks are important because they carry rumors of sociological current. Because networks are private, it is hard to estimate where they reach, but in the case of nature programs for urban children, it is clear that the reputation of a program and its core staff influence the constancy of return rates. In Moreno's terms, networks are "the kitchens of public opinion. It is through these channels that people affect, educate or disintegrate one another. It is through these networks that suggestions are transmitted."

Moreno devised sociometric tests to examine social structures by measuring the attractions and repulsions between individuals within a group. Moreno cautioned that it is a difficult psychological problem to introduce a sociometric instrument into a small community since it may be painful or unpleasant for a particular individual to find out his position in the group. For the present studies, there was little resistence to a sociometric measure since that measure was only a small part of the total instrument. Preparation for the sociogram came through the rapport developed earlier in the interviews. There seemed to be a little consciousness or resistence among the children to the sociogram items. In both 1972 and 1974, at the end of the interview, each child was asked, in Question 31, "If you could choose three people from camp to go on a hike with you, who would you choose?" After the three choices, children were asked to classify the individual chosen as to whether they were: camp friends, workers at the camp, counselors, school friends, neighbors, or relatives.

The hand analysis of sociometric data consisted of drawing conventional sociograms with circles for individuals or squares for categories of individuals who were not actually interviewed. Returnees are marked by a double circle and dyads are shown by arrows. A dyad is a union of two people. Moreno indicates that the level of social group cohesion is high if the number of dyads is larger than one-half the membership, thus allowing for chains, triangles, stars, and more complex structures to form. By this definition, all the camps are cohesive social oups.

Computerized analysis of the sociogram esults consisted of constructing a matrix for l choosers and all chosen individuals. Each ild was scored on the number of choices he she made, and on the number of times he or e was chosen. The total number of crossovers age, race, sex, counselor group, and type choice; e.g., staff, camp friends, school iends, neighbors, relatives. The number of eciprocal and non-reciprocal choices was com- ited for the entire samples.

nship

At the Nature Center in 1972 there were ght pairs of siblings, four groups of ree siblings, and one group of four siblings gistered. This means that of thirty-two ople, eleven had blood relatives in the pro- am. There were three sets of two siblings, e set of a mother and two offspring, and one t of a mother and one offspring. Among the ban children registered, there were ghteen sets of two siblings, four sets of ree siblings, and three sets of four sib- ngs. Thus, sixty people, or 43 percent of e sample population, had a blood relative the program.

At the YMCA/YWCA Camp in 1973 there re twenty-three sets of two brothers, three ts of three brothers, and one set of four others. There were twenty-nine sets of two sters, five sets of three sisters, eleven o-member brother-sister combinations, one ree-member combination, and two four-member mbinations. In this case, 165 children, or er 19 percent of the 859 children registered, d a blood relative attending the program.

Composite attendance figures provided the Scout Program do not contain information the number of siblings attending camp to- ther. Occasionally, relatives attend camp gether. Two percent of sociogram choices re for relatives. At the Resident Camp ogram in 1973 there were twenty-five sets two same-sex siblings, and two sets of ee same-sex siblings. There were also teen sets of opposite-sex siblings in rs, and two sets of three-member brother- ter combinations. This means that ninety- people, or nearly 38 percent of the 245 gistered children had one or more blood lings in the program. In short, when an children go to natural environments in anized groups, many of them bring their sting social networks with them. When y return home, camp experiences have high ry-telling value. Shared experiences, asant or unpleasant, bind groups together o larger social networks or a web of group iliation. Table 1 summarizes the extent of pre-existing networks.

TABLE I

Results of Network Analysis
Showing Pre-Existing Networks

Program Type	% of Children with 1 or more Sibling Present	Total 1972-73 Registration
Nature Center	44%	72
Museum Program	43%	60
Day Camp	19%	859
Neighborhood House	59%	295
Scout Camps	38%	245

Kinship groups are highlighted in the sociogram in Figure 1. Siblings and cousins present are marked with R for relative. Such blood relationships among children are not immediately obvious because children are scattered across the campsite, and they may have different last names on attendance lists. Therefore, asking a child to categorize choices is very useful.

Neighborhood

These groups were the most conspicuous at the close-knit Neighborhood House Camp. Reported neighbors are shown in Figure 2, along with a high number of returnees. Neighbors were also evident in Nature Center and YMCA/YWCA camps. Neighbors were less frequent in the Scout Camps and Private Camp because these programs draw from a wider geographic area. When neighbors attend camp together, camps become an important extension of urban neighborhoods, and like neighborhoods, are "the place where children are brought up to become members of their own society".

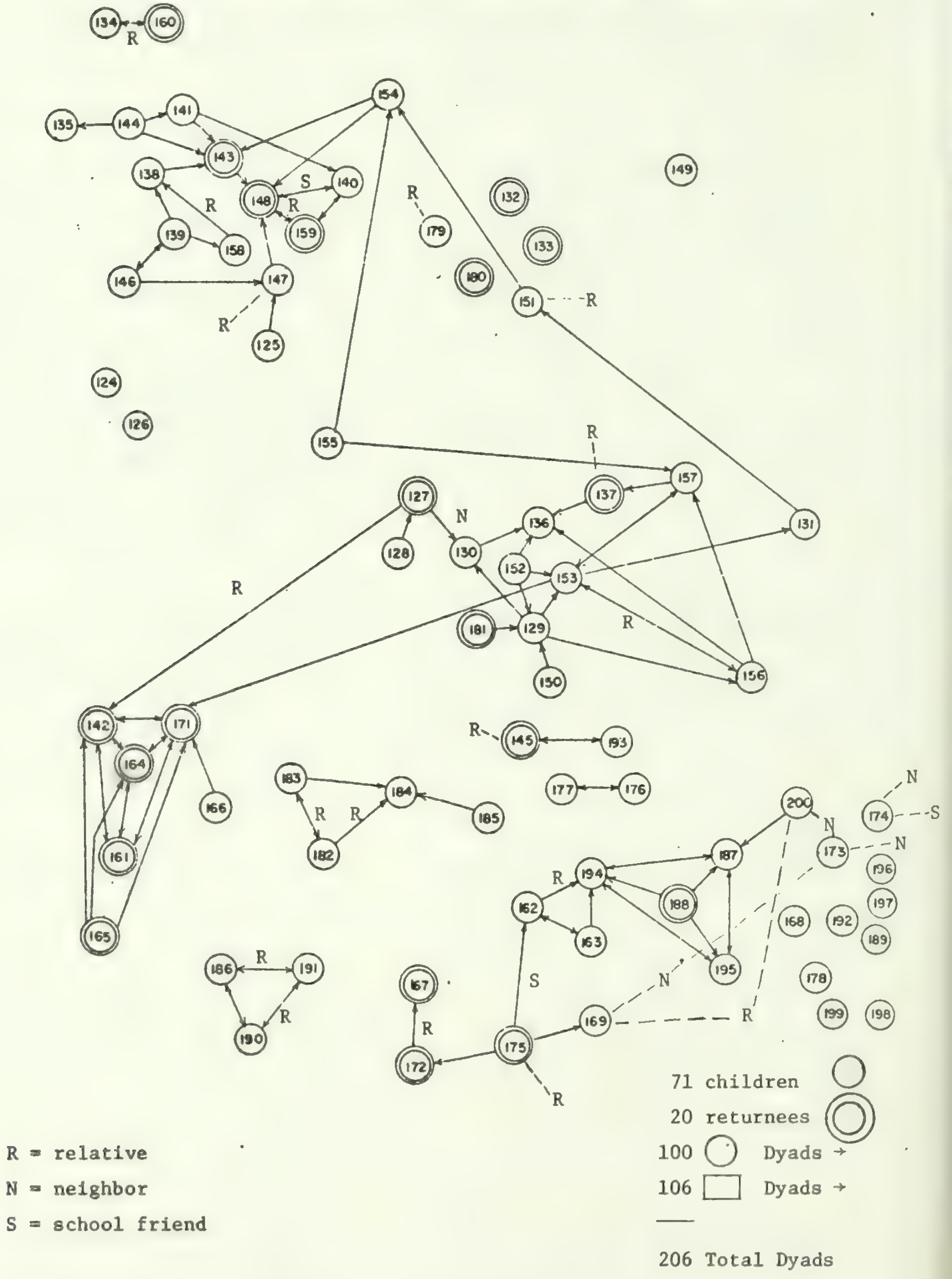
Neighbors live in proximity, by definition, and this may "necessitate many contacts of human beings and cause inurement to and intimate knowledge of one another". This knowledge is transposed to camp, and it affects the children. Neighbors also communicate sentiments and opinions about returning to camp together.

Friendship

This bond "comes most easily into existence when crafts or callings are the same or of similar nature". Friendship, though independent from neighborhood and kinship, requires "easy and frequent meetings". Friend-

Figure 1

YMCA/WYCA PROGRAM SOCIOGRAMS WITH RETURNEES AND KIN GROUPS (R)



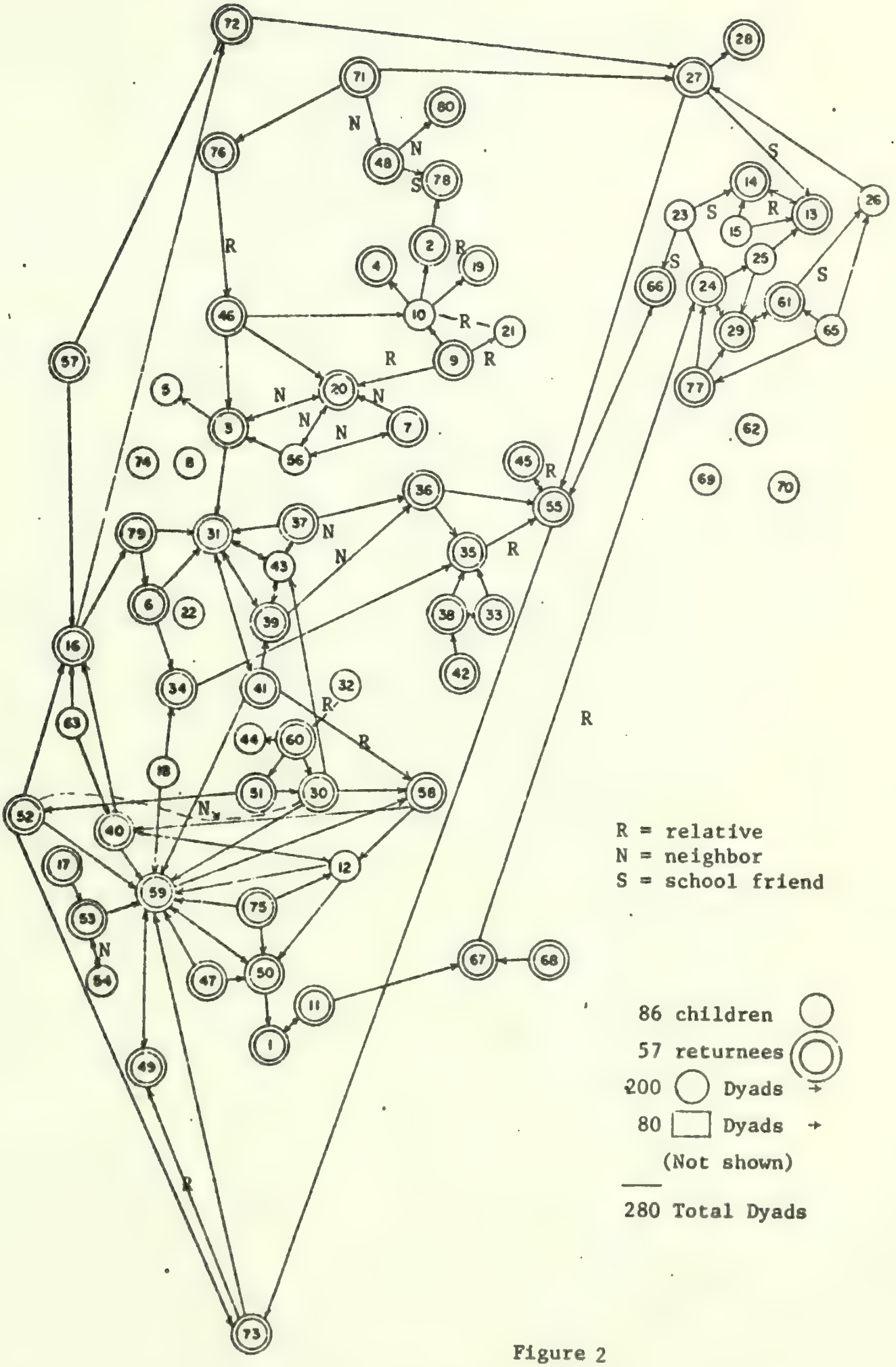
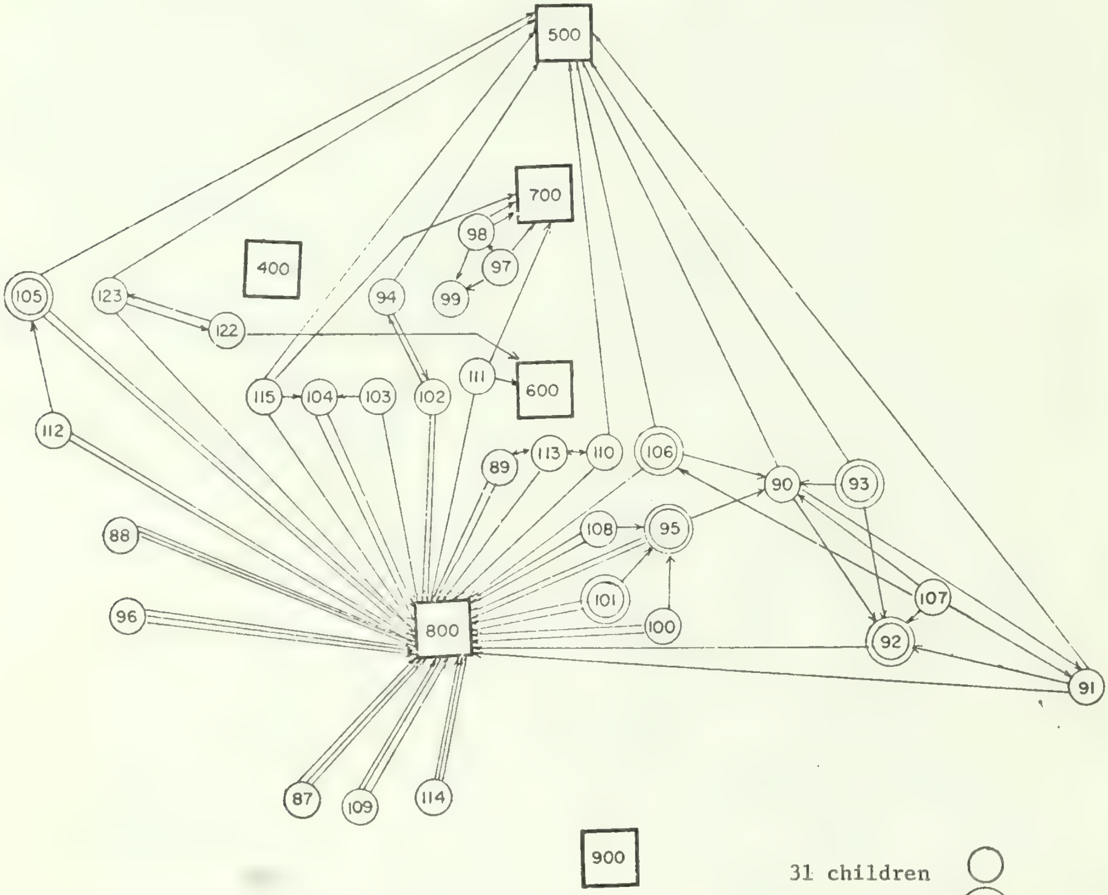


Figure 2

NEIGHBORHOOD HOUSE CAMP SOCIOGRAM WITH RETURNEES AND NEIGHBOR GROUPS - N ship among children or junior staff and children is conspicuously illustrated in Figures 2 and 3.

Figure 3

MUSEUM PROGRAM SOCIOGRAM WITH RETURNEES AND OTHER GROUPS



400 = Program Friends
500 = Neighbors
600 = Relatives
700 = School Friends
800 = Junior Staff
900 = Senior Staff, Program Director

31 children ○
6 returnees ◎
28 ○ Dyads →
58 □ Dyads →

86 Total Dyads

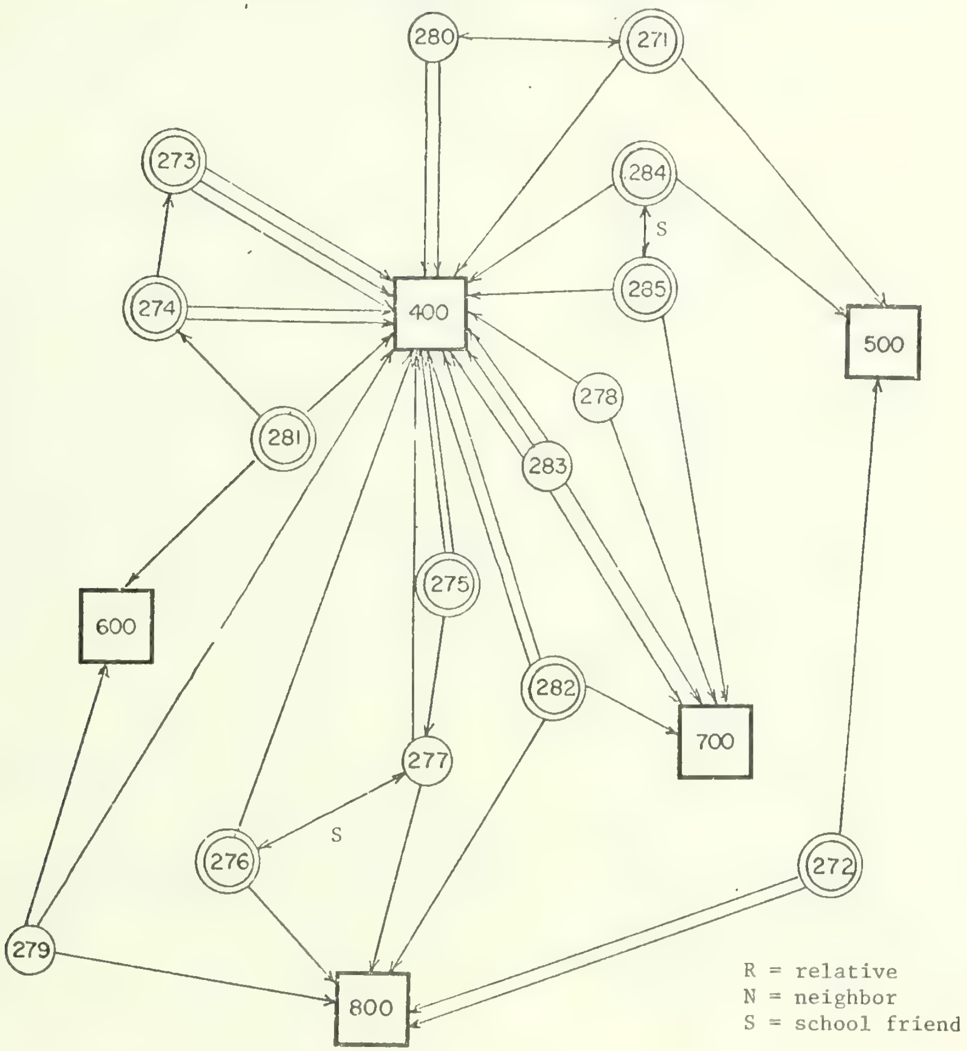
At the Museum Program, forty-two choices were made for junior staff from a total of eighty-six total dyads. There are several possible explanations. Since choices were made on three separate days, in three separate locations, a response groove is unlikely. The task for this sociogram was hiking, and many of these urban children are inexperienced in the woods, so it would be logical to choose companions who have been hiking there before. Finally, unlike most camps where junior staff are predominantly from a higher social class, these junior staff were mainly from the same social, racial, and ethnic groups as the children. This homogeneity in social background could account for such strong friendship bonds.

At the Scout Camps, friendships were conspicuous without reference to kinship or neighborhood groups as illustrated in Figure 4. This finding is consistent with the mission of scouting.

In summary, although kinship extensions are generally dissolved in modern urban families, nature oriented, children's camps may serve as surrogate extended families. Outdoor programs show higher levels of group cohesion because they incorporate preexisting kinship and neighborhood groups. Friendship groups and returnees add further cohesiveness

Figure 4

SOCIOGRAM FOR SCOUT CAMP C
WITH RETURNEES AND FRIENDSHIP GROUPS



400 = Program Friends
500 = Neighbors
600 = Relatives
700 = School Friends
800 = Junior Staff
900 = Senior Staff, Program Director

15 children ○
10 returnees ◎
9 ○ Dyads →
38 ▭ Dyads →
47 Total Dyads

to groups of children in natural environments.

B. Development of Group Cohesion

How does group cohesion develop in the milieu of children's outdoor programs? Research on returnees suggests that some interrelated factors are important. This is not the simplest explanation, but it best encompasses the evidence. Burch (1971) notes "habitat-societal interactions do not fall into a neat deterministic pattern".

Natural Environments

First, a defined natural territory served as a focus for group interactions and a substrate for group cohesion. Coincidentally, in the Museum Program where territory is borrowed and only in use temporarily, return rates were much lower. None of the natural environments are unique or pristine, but all are available to large number of children. There is enthusiasm and obvious pride in ownership or exclusive use of natural areas, even if use is temporary. However, outside camp preferences for nature per se were rarely mentioned by this sample of children. Six percent of leisure preferences away from camp and 7 percent of preferences within the program were classified as nature-related.

Note that nature means the physical environment or acts having to do with natural scenery, birds, trees, flowers, etc. The Latin root word natura means born, and there are many connotations besides physical environments. Burch writes perceptively of different meanings people give to nature:

> The habitats of human societies are not solely the function of ecosystem characteristics. Rather nature is always composed within a specific frame of motive and expectations.... and these selective perceptions determine whether the nonhuman environment will become a resource, a taboo, or remain unseen.

Networks analyses such as the ones in Figure 1-4 reflect the cohesiveness of social groups where many neighbors, school friends and kin-groups co-exist and use resources together. A high number of returnees and a return rate of 35% typify this neighborhood house group.

The highest return rates were found in a year-round nature center. Children walk to the nature center and the return rate is over 48%, although there is a smaller total group size and hence more individualized attention.

Incidently, where children are picked by schools in an effort to equitably distribute a scarce resource, return rates dropped to a little over 6%. Where there is more time in a program over a longer time frame, say 3-5 years, there is a much higher adoption of resource management related careers in later life. Therefore, one of the most subtle but significant long-term outcomes of exposing urban children to nature related resource systems is the nurturing of resource based values and conservation aesthetics. Whether the programs create such values de novo is not clear, but the nurturing function is far more critical.

WHY IS NETWORK ANALYSIS
USEFUL IN RESOURCE MANAGEMENT?

Network analysis is useful in resource management because it helps to clarify the following key elements of the human/resource complex:

- the final demand for recreation resources desired by a given society or social group;

- the spatial pattern of resources, potential resources and resource users (both current and future users);

- the quality of the resource related experience;

- the carrying capacity and reuse potential of resources;

- the resource costs and human impacts generated as a byproduct of very intense resource use;

- the interrelationships of resource users to ordinary natural environmental processes and transformations of the resource base with use;

- ambient conditions of overall environmental quality;

- final health, safety and environmental protection measures associated with the use of the land and associated physical and biological resources;

- impacts of resource use pattern changes on plants, animals or people;

- responses of individual elements in the resource use complex;

- local, regional and national governmental and institutional arrangements tied to the resource use patterns; and,

- strategies for implementing changes in the quality of the resource and the management of future resources in times of increasing resource scarcity.

This approach to resource management is patterned after Bower, (1977).

WHERE DO WE GO FROM HERE?

In a time of declining or stable births, when there are fewer eight to thirteen year olds to be served, resource managers can logically expand the ages and life cycle stages served and/or improve the quality and service given existing populations now served.

The first is a competitive approach, while the second is more cooperative in orientation.

Either approach is better if network analysis is done, at least implicitly. By measuring the user trends, beyond one annual cycle and from year to the next, resource managers can become alerted to the stability elements in the resource complex, eg. returnees enhance the quality of predictability and regularity in this resource complex. In this case, there are indications that lengthy pleasant experiences carry forward into earlier choices and throughout the life cycle into maturity.

However, it is a mistake to believe that the transfer along networks is automatic or always positive.

Dislike for forest resources are conveyed just as efficiently as positive preferences. If we are to better manage dwindling resources, it must be with a careful regard for existing networks of resource users.

REFERENCES

Allen, R. H. 1977. Children and Nature: A Field Study in Sociobiology. Ph.D. Dissertation. New Haven: Yale University.

Boissevain, Jeremy and Mitchell, J. Clyde (eds.). 1973. Network analysis Studies in Human Interaction. The Hague, Netherlands: Mouton & Co.

Bott, E. 1977. In Social Networks: A Developing Paradigm. Edited by Samuel Leizhardt. New York: Academic Press, Inc. pp. 253-292.

Bower, B. T., ed. 1977. Regional Residuals Environmental Quality Management Modeling. Washington, D.C.: Resources for the Future. p. 8.

Burch, W. R., Jr. 1971. Daydreams and Nightmares: A Sociological Essay on the American Environment. New York: Harper and Row. p. 50-51.

Gans, H. 1962. The Urban Villagers. New York: The Free Press.

Laumann, E. O. and Pappi, F. U. 1976. Networks of Collective Action: A Perspective on Community Influence Systems. New York: Academic Press, Inc.

Mead, M. 1972. In Human Identity in the Urban Environment. Edited by Gwen Bell and Jacqueline Tyrwhitt. Baltimore: Penguin Books. p. 245.

Moreno, J. M. 1960. The Sociometry Reader. Glencoe, Ill.: The Free Press. p. 440-450.

Spurr, S. H. 1969. In the Ecosystem Concept in Natural Resource Management. Edited by George M. Van Dyne. New York: Academic Press, Inc. p. 3.

OUTDOOR RECREATION TREND RESEARCH: MAKING THE POSSIBLE PROBABLE[1]

Geoffrey Godbey, Professor
Recreation and Parks
The Pennsylvania State University
University Park, PA

Outdoor recreation research has largely ignored the fundamental requirement of science that findings be replicative. "The only way to establish replicability, of course, is to replicate."[2] Because of this, we know practically nothing about outdoor recreation trends. 'Trends, in statistics, (is) a steady change in a variable or set of related variables in a certain direction (for example, a steadily increasing magnitude or frequency of occurrence of a variable) for a period of time."[3] Any definition of trend implies the systematic observance of a phenomenon more than one time. This time period must be one that is great enough that it does not measure merely cyclical fluctuation. The Dictionary of Sociology alludes to this in defining a secular trend: "A long-term trend, that is, a trend that permits for a long enough period of time so that it is clearly not merely a phase of a cyclical movement. Cyclical fluctuation may occur in the course of a secular trend, but there is always a clear, long-range movement in a certain direction despite the short run variations."[4] In outdoor recreation research, for example, we might find that camping in developed areas varied cyclically according to whether it was a week day or week end and according to month of the year, but no secular trend can be established unless we measure such camping in more than one year.

Trend analysis should be understood as ne form of aggregation. Aggregation accomlishes two purposes: it reduces errors of measurement and it establishes a range of generalization. Perhaps the most common form of aggregation is aggregating over individuals to reduce errors of measurement associated with individual differences.[5] Thus, we are likely to seek to sample among subjects with reference to individual differences which may constitute variables which intervene upon the relation between the dependent and independent variable.

Another form of aggregation is aggregation over stimuli and/or situations to reduce error variance associated with the unique contribution of specific stimuli or situations and determine the class of stimuli or situations to which the results can be generalized.

Thirdly, we may aggregate over different research measures to minimize variance associated with a single method rather than true variance.

When we replicate a study we are aggregating over trials or occasions since, not only may there be high component of error of measurement, but also since otherwise there is no way of determining whether the results can be generalized over time.

Ideally, research in outdoor recreation would seek to aggregate in all four of these areas, but historically it has only usually attempted to aggregate over only individuals and occasionally over stimuli or situations or measures. The scant attention to replication (aggregating over trials or occasions) means we know little about change and the direction of change in outdoor recreation. The consequences of this situation are great. For instance, we have little idea if the satisfaction levels of users of national parks have increased or decreased in the last decade. We don't know if tennis is more popular this year or last. It is not possible to say if income is a better prediction of participation in water skiing now than it was a decade ago. Is crowding more or less a problem in the mind of state park users than it was five years ago?

A number of situations explain why so

---

[1] Paper presented at the National Outdoor ecreation Trends Symposium, Durham, NH, April 0-23, 1980.

[2] Seymour Epstein, "The Stability of Beavior: Implications for Research," in press, 980. American Psychologist.

[3] George A. Theodorson and Achilles G. Theodorson, Modern Dictionary of Sociology. ew York: T.Y. Crowell, 1969, p. 442.

[4] Ibid, p. 443.

[5] op cit, Epstein, p. 19.

little replication of outdoor recreation research takes place. Such explanations are more in the political, financial and organizational realm than in the methodological realm.

SITUATIONS MITIGATING AGAINST LONGITUDINAL RESEARCH

While a number of methodologies exist for conducting longitudinal research, the following situations have usually meant outdoor recreation research has been largely cross-sectional.

1. Replication of studies has generally been considered low status by social scientists. Many journals won't publish replications of existing studies.

2. Funding for outdoor recreation is usually extremely tenuous. The researcher is often encouraged to "do something quick".

3. Research done in-house by government agencies concerned with outdoor recreation is politically sensitive and subject to change without notice. No state or federal agency can guarantee that a program of outdoor recreation will last for longer than four years at most, and usually for not more than one. New administrators, new researchers, new financial situations, changes in political constraints, demands of agency constituencies -- all these factors mitigate against trend research. As the Committee on Assessment of Demand for Outdoor Recreation Resources of the National Academy of Sciences put it:

"Although surveys have been a dominant form of data gathering and analysis in outdoor recreation for many years, much of the richness of the resulting information has been lost because of lack of comparability of survey questions and sampling methods over time and over geographic areas as well as the limited scope of these inquiries. The ability to detect trends and changes in perceptions, attitudes and preferences vis-a-vis outdoor recreation has been limited by the lack of comparability of sample design and questionnaire format over time."[6]

Surveys undertaken by the (then) Bureau of Outdoor Recreation in 1960, 1965, and 1972 illustrate this problem. As a recent, extensive assessment of these studies concluded:

"The biggest problem in these surveys were the biases which affected responses. Using 1960 as a base, the 1965 survey had a somewhat positive bias, while the 1972 survey had a definite negative bias in reporting of activity participation. These biases, in large part, were due to the inconsistency of survey design over time. This inconsistency affected comparison."[7]

4. A related problem is the lack of systematic data storage, which means that it is often impossible to fully compare replicated surveys with the original data base. It should be noted that some steps are being taken to help minimize this problem. First, an attempt is being made to establish a National Leisure Archive by HCRS, U.S. Department of Interior in cooperation with the University of North Carolina Institute for Research in Social Sciences.[8] Initially, the project will focus upon studies generated by State and Federal governments. All data archived will be available to member institutions of the University of Michigan's Institute for Social Research without charge.

A second project, the establishment of a Leisure Information Network, holds promise for data storage pertaining to leisure at an international level.[9] At a recent conference in Brussels sponsored by the World Leisure and Recreation Association and the European Leisure and Recreation Association, the first steps toward international storage and dissemination of data were undertaken. A linking of existing centers storing leisure data is already being explored, as are other related undertakings. The success of both these projects remains to be seen.

5. Also related is the problem of incomparability of operational definitions from study to study. While attempts have been made to establish a thesaurus of outdoor recreation term, to date, walking for pleasure, hiking and backpacking may have overlapping meanings or even be used interchangably from study to study. The same problem exists with regard to unit of measurement. No commonly accepted interval or ordinal measures have emerged in regard to participation or other subjects of inquiry. One reason for this is a lack of agregation of methods in such research which

---

[6] Committee on Assessment of Demand for Outdoor Recreation Resources, National Academy of Sciences, Assessing Demand for Outdoor Recreation, Washington, D.C.: NAS, 1975, p. 42.

[7] Kirschner Associates, Inc., Interim Report--Evaluation of Five Previous Nationwide Citizen Surveys, Washington, D.C.: unpublished, 1975, p. 111.

[8] National Leisure Archive, John Peine, Project Coordinator, HCRS, U.S. Department of Interior.

[9] Leisure Information Network Conference, Gerald Kenyon, Chairman; University of Waterloo, Waterloo, Ontario, Canada.

makes any judgements about measurement effects purely speculative. While the issue of validating such measures is important, any measure which is replicated at least has the advantage of producing a consistent error. Perhaps this is one reason why many commercial organizations concerned with outdoor recreation will pay high prices for the results of periodically replicated surveys of participation undertaken by A.C. Neilsen and other private-sector pollsters.

6. Social science changes its focus with regard to outdoor recreation, as with other subjects, and such changes often lead to discontinuity. Research concerns such as crowding, motivation and satisfaction, and life stage and life cycle ebb and flow in popularity as well as evolve and such change discourages trend analysis.

These and other situations, many of which are not unique to outdoor recreation, have discouraged research into outdoor recreation trends. It would appear, however, that many things can be done to promote such research.

PROMOTING TREND RESEARCH

Given the previously outlined problems, what can be done to promote outdoor recreation research which is more than purely cross-sectional? It appears that few of the answers involve breakthroughs in methodology.

1. One step in the right direction would be to encourage outdoor recreation researchers to alter cross-sectional research designs to include retrospective or projective aspects. "It is possible in many cross-sectional surveys to incorporate certain characteristics of a longitudinal approach by conducting a retrospective pretest in which respondents are asked to recall their attitudes or behavior at any earlier point in time as well as the present."[10] Additionally, surveys can ask respondents to project future behaviors. While those steps will not, strictly speaking, produce trend data, they will give implication as to the direction of change of the phenomenon under study.

2. Those who promote, plan, fund and advise outdoor recreation research can encourage the replication of existing studies. Within colleges and universities, this may involve encouraging replication of worthwhile theses and dissertations as well as secondary analysis of two or more identical or similar data sets. In local, State and Federal Government, officials need to be made aware of the wastefulness of many of the cross-sectional research efforts which they undertake. There is also the need to inform officials of the benefits of replication of studies to outdoor recreation planners and managers. Among such benefits are economy and simplicity as well as the benefits of identifying trends.

At the state level, the State Comprehensive Outdoor Recreation Plans provide an opportunity for replication which could be systematically encouraged by HCRS. While standardizing SCORPS among states is neither possible nor desirable, replication, in an era of diminishing funds, could be very attractive to individual state outdoor recreation agencies.

At the federal level, it seems unlikely that research done in-house can be planned for more than four years. It may be possible, however, to give funding priority to longitudinal research and the replication of existing studies. Additionally, federal funding can be used in combination with other funds to establish a research-oriented center for the study of outdoor recreation or leisure behavior. Such an intermediate organization would potentially have advantages of stability and a minimum of political interference which could facilitate a long-term program of trend research. To date, no such center exists which is financially secure.

3. In the public, private and commercial sector, greater research efforts of a trend analysis nature can be made using data which is already being collected. Data concerning leisure monetary spending, attendance at state parks, and other subjects is often collected but never analyzed.

4. A more systematic attempt at data storage and dissemination may continue to be problematic in spite of the encouraging preliminary work concerning a National Leisure Archive and the Leisure Information Network. Underlying this problem is the continued lack of a single organization with both resources and a deep and stable commitment to recreation and leisure research. Much of the "non-comultive effect" of recreation and leisure research reflects this situation.

5. In longitudinal research involving panels of respondents, outdoor recreation researchers can urge the inclusion of limited questions pertaining to outdoor recreation. To date, most of the valuable longitudinal data collected about recreation and leisure has come from studies whose primary concern has been some other subject. This situation is likely to continue.

---

[10] Gerald Ferman and Jack Levin, Social Science Research, New York: John Wiley and Sons, 1975, p. 42.

6. Whenever it appears intellectually legitimate, outdoor recreation researchers can utilize the same definitions, units of measurement, sampling procedures and methods of analysis of past studies. In many instances, for example, changes in activity descriptors or scaling of periods of recall have not advanced understanding since no attempt was made to validate either those measures which were discarded or those measures which replaced them. In other words, if you don't attempt to validate the measures you use, use someone else's.

In all these ways and others, outdoor recreation researchers can move closer to establishing trends in outdoor recreation. While methodological innovation may be necessary, the most important constraints appear to be a) the attitudes of outdoor recreation researchers; b) finanical constraints and c) organizational and political constraints. Progress in minimizing these constraints will necessitate expanding the consciousness of both users and producers of outdoor recreation research to the benefits of and need for trend research. Only then will the possible become probable.

TRENDS IN FEDERAL LAND ACQUISITION, PROTECTION STRATEGIES, AND PLANNING

Warren Brown[1]
Resource Policy Analyst
Division of Federal Lands Planning,
Heritage Conservation and Recreation Service
Washington, D.C.

INTRODUCTION

In the past, Federal land acquisition has been one of the most popular ways to protect outstanding natural resources and provide recreational opportunities. Federal purchase, maintenance, and operation can help take pressure off the State or local budget. Federal involvement also can provide a way for local officials to avoid making some tough decisions about regulating private development. However, several trends are raising obstacles to proposals for establishing new Federal management units in the years ahead.

First, and most obvious is the budget crunch. Appropriations for Federal land acquisition have been reduced substantially, in spite of increasing numbers of new projects and proposals. Second, financial constraints and changing public attitudes about Federal land management have encouraged a trend toward finding and using alternatives to fee-simple purchase. These factors have led to some new directions in policies and planning procedures which will be discussed as a third trend in recreation programs.

Financial Constraints

The Land and Water Conservation Fund provides the primary source of support for Federal land acquisition. The Fund was established in 1965 with the broad purpose to:

> "assist in preserving, developing, and assuring accessibility . . . to such quality and quantity of outdoor recreation resources as may be available and are necessary and desirable . . . to strengthen the health and vitality of the citizens of the United States ..."[2]

The LWCF Act emphasized the lead role of the States in providing recreational opportunities and established the 50/50 matching grant program of Federal assistance for land acquisition and development. The Act also recognized the important role played directly by the Federal government in acquiring land for National Parks, Wildlife Refuges, Forests, and Recreation Areas.[3]

The LWCF originally was authorized at $100 million each year through 1989 with at least 40% available for Federal purposes. This level of funding may have seemed adequate in 1965, but new acquisition projects and rising land prices have continued at rates never before anticipated.

In 1970 the authorized level of the LWCF was increased to $300 million each year. By 1980 the level had been increased to $900 million annually. However, claims against the Federal side have increased to $2.9 billion.

Receipts from Outer Continental Shelf oil and gas leases now provide most of the income to support the Fund. Nevertheless, price escalation is eroding the purchasing power of the funds which are available. In 1963, the average cost per acre for Federal purchases was estimated to be $75. During the first 14 years of the LWCF program the average price per acre paid by Federal

---

[1] Paper presented by Warren Brown, Resource Policy Analyst, Division of Federal Lands Planning, Heritage Conservation and Recreation Service Outdoor Recreation Trends Symposium, Durham, N.H., April 23, 1980.

[2] Land and Water Conservation Fund Act of 1965, Sec. 1 (b).

[3] Bureau of Outdoor Recreation, "The Land and Water Conservation Fund: Intent and Accomplishments", National Urban Recreation Study Technical Report No. 9; July 1977.

Agencies was $691.[4] In 1965 - 66 the value of farm real estate was increasing at a rate of 3% each year.

In 1978 - 79 the price of farmland went up 16% on average around the nation with rates above 20% in many western states.[5]

These data show some simple trends which should come as no surprise. Prices are going up rapidly and new demands are being placed on the funds which are available. Appropriations for the Federal land acquisition program have not been able to keep up with rising prices. Assuming a modest 14% rate of land price escalation, even if Congress appropriates the full $360 million authorized for the Federal side of the LWCF each year through 1989, there will be enough money to buy less than one half of the land already identified for purchase.

In spite of the shortage of money, there is no shortage of additional areas deserving protection or the willingness of Congress to establish new acquisition projects.

Alternatives to Fee

Money is not the only obstacle to the Federal land acquisition program. State and local governments frequently oppose Federal purchases which remove land from the tax rolls and economic base. Landowners frequently don't want to sell and are becoming well organized to voice their interests. Although the "Sagebrush Rebellion" has focused on State control over current BLM lands, it is another sign of the growing opposition to the Federal land managing presence

The General Accounting Office recently released a report entitled "The Federal Drive to Acquire Private Lands Should be Reassessed."[6] GAO's image of the Federal "drive" and its criticism of agencies' land acquisition programs are somewhat exaggerated. For example, since 1965 Federal agencies under the LWCF program have purchased about 2.6 million acres - only about one-tenth of one percent of the nation's land. Nevertheless, the GAO report has become one of several factors simulating a review of the Federal land acquisition program, encouraging more attention to alternatives to direct purchase and management.

"Alternatives" in land acquisition have usually been limited to the question, "to buy or not to buy." Different boundaries also have been considered as the only real "alternatives" for the extent of purchase. In the years ahead we can expect more serious consideration to a wide range of techniques which do not necessarily involve direct Federal acquisition or management. These alternatives include many different approaches, some well tested and others quite new, which fall into several categories.

At one end of the spectrum, there is the educational and awareness approach which attempts to promote public and landowner stewardship. State Heritage programs and the National Landmarks Program administered by HCRS provide examples of how private recognition, may be persuaded to voluntarily protect their land. Although these programs are primarily oriented toward protecting natural areas, they can help conserve a landscape, geological formation, or other resources with important recreational values as well.

Coordination and consistency requirements can provide a useful complement to programs of education and recognition. The Coastal Zone Management program provides one example of an effort to assure that Federal financial assistance and licensing activities are consistent with a comprehensive plan which includes at least some attention to recreational values. The Statewide Comprehensive Outdoor Recreation Plan may be so general that "consistency" is difficult to enforce, but in many instances improved coordination in Federal programs through the SCORP can help protect areas of special recreational value. By targeting a variety of other Federal programs of financial and technical assistance it may be possible to avoid the need for direct Federal purchase and management.

Several types of administrative arrangements or techniques are available to help implement voluntary and cooperative methods of protecting recreational resources. A Memorandum of Understanding or Agreement can provide additional support for less formal arrangements for coordination and consistency in actions by Federal or State agencies. For example, HCRS has a Memo of Understanding with the Environmental Protection Agency to help assure that recreational factors will be considered in planning for wastewater treatment.

Contracts and service agreements also provide administrative approaches to providing recreational opportunities. The cooperative management program conducted by HCRS is one example of how an administrative agreement can open for public use some Federal lands owned by the military or other agencies not primarily concerned with recreation. At the State and local level, an agreement to pick up trash or provide minor maintenance services may be all that is needed to make an area available for public recreation.

---

[4] Data from HCRS, Div. of Fed. Lands Planning Files.

[5] U.S. Dept. of Ag., Economics, Statistics, and Cooperatives Services, "Farm Real Estate Market Developments", March 1980. See also, Bureau of Outdoor Recreation, Recreation Land Price Escalation, Jan. 1967.

[6] U.S. General Accounting Office, The Federal Drive to Acquire Private Lands Should be Reassessed, Report CED-80-14; Dec. 14, 1979.

Regulatory tools are another category of methods for achieving recreational objectives. Zoning, and building or public health codes can control development to protect open spaces and conserve natural resources. Innumerable combinations of zoning and subdivision controls are available to meet the challenges posed by most rapidly-developing areas. Creative use of clustering, planned unit development, and site plan approvals can help guide growth in a way that keeps important open spaces available for public use. By establishing mandatory dedications, set-backs, reservations, and other contributions toward public services, local governments can assure that new developments make a positive contribution toward providing recreational opportunities.

Air and water quality regulations at the Federal, State, and local levels also can in some cases provide viable alternatives to acquisition. The Corps of Engineers Section 404 Permit program provides an example of how regulatory techniques can protect wetlands which are critical to recreational values as well as important natural processes.

Regulatory, administrative, and educational techniques have their place, but in some cases the recreational objectives require a degree of control or public access that can be achieved only through acquisition. Where purchase is necessary, it may be possible to buy something less than the full fee.

Looking at property ownership as a "bundle of rights", it is possible to acquire only those interests in land necessary to achieve certain objectives. Development, timber, water, mineral, grazing, or other rights may be all that the public needs to own in order to protect important natural areas or recreational and scenic values. These rights may be obtained by purchasing an easement that restricts the owner's activities. However, easements also may be positive, for example by establishing a public right to access.

In England and Wales a network of more than 140,000 miles of footpaths and bridleways provides for public access and recreational use across private lands. These public right-of-way go back to the earliest periods of common law and history, but they have been kept open by citizen activism and dedication.[7] In the United States, affirmative easements have been used to provide public access for hunting and fishing, nature study, and other recreational uses on a limited scale.

Partial interests in land also can be retained when it is sold. Reserved interests in the form of life tenancy for the previous owner are not unusual when the Federal government buys land. Purchases with subsequent re-sale subject to deed restrictions provides another way to get only that interest in the property which is absolutely necessary. Purchase and lease-back arrangements also are available to most Federal agencies, but these methods have not yet been used extensively as an alternative to fee-simple purchase.

If acquisition of fee or less than fee interest is desirable, there are many ways to go about it. Because of tax benefits available, many people can be encouraged to donate all or part of their land or to sell at a bargain price. Public spirit and the tax benefits can also encourage donations of conservation easements. Land exchanges provide another way for public agencies to obtain land they want without giving up cash.

Choosing the Best Technique

In brief, there are a tremendous number of alternatives to acquisition. The problem facing the resource planner or manager is, which one should I use? Indeed, the challenge of the years ahead is to develop and enhance "craftsmanship" in formulating land protection strategies. There is no simple formula to say that easements are "better" than full fee or that regulatory approaches work when educational efforts fail. Each case must be evaluated on its own merits considering several basic factors:

First, the character of the resource must be considered. An area suitable for intense public use will require different strategies from a fragile ecosystem where recreation is a secondary and relatively minor value. Location, accessability, and natural characteristics must be reviewed on a case by case basis.

Second, management objectives must be clearly defined with precision. The type of activity planned will usually determine what interests in land need to be acquired or protected. A scenic vista may be protected by zoning for agricultural use, at the expense of more opportunities for public access which could be available with easements or other types of development controls. Although intense public access usually requires public ownership, it may be possible to limit purchase or controls to a few trails or corridors to provide recreational opportunities.

---

[7] See remarks of Robert L. Herbst, Assistant Secretary for Fish and Wildlife and Parks, U.S. Dept. of the Interior, at the Sierra Club Board of Directors Meeting, Nov. 11, 1978. San Francisco, California.

Landowner interests and market conditions also are important in selecting appropriate tools. Where development pressure is weak, it may not be difficult for educational approaches to work. Where rising taxes and growth potential are strong, landowners are less likely to voluntarily give up any rights to the land they hope to develop.

Finally, political realities are an important consideration too often overlooked or misinterpreted in selecting an appropriate technique. Many of the most appealing ways of controlling impacts on recreational resources are simply not feasible politically. Zoning which is well accepted in many metropolitan areas may still seem to be an unthinkable intrusion on private property rights in some rural counties.

Sensitivity to political reality is important, but we cannot be too shy about proposing innovative approaches for fear of adverse reactions. Where opposition is expected to arise, it may be possible to generate the necessary popular support before a protection strategy is dropped as politically impractical. Although many alternatives to acquisition may generate political controversy, there may be even more opposition to Federal or state acquisition of private land. Sometimes politically sensitive regulatory approaches may prove to be a popular substitute for direct acquisition and displacement of current owners.

Policies and Planning Procedures

In response to the financial and political constraints on direct Federal land acquisition new trends in policies and planning procedures are developing. In the past, each Federal agency has followed its own policies and procedures in planning for new national areas and determining what protection techniques will be used. Following recommendations of the Third Nationwide Outdoor Recreation Plan, some important steps have been taken in recent months to improve the new area study process and help assure that agencies using the Land and Water Conservation Fund consider a full range of alternatives to fee-simple acquisition.

First, a Memorandum of Understanding has been adopted by the Directors of the Bureau of Land Management, Fish and Wildlife Service, Heritage Conservation and Recreation Service, National Park Service, and the Chief of the Forest Service outlining the responsibilities of the Land and Water Conservation Fund Policy Group (LPG). The LPG recommends on how the Federal side of the fund is to be allocated each year and coordinates the studies of potential new areas. The group is composed of the agency Directors and is chaired by the Deputy Assistant Secretary for Fish and Wildlife and Parks.

The LPG has been operating in a different form since 1974 primarily to formulate budget requests. Under its new mandate, the LPG will play a more active role in recommending what areas will be studied, who will conduct the studies, and what areas should be recommended for acquisition or other types of Federal protection.

The LPG has adopted a planning and decision-making process to carry out its responsibilities concerning studies of potential new national areas or major expansions in existing areas which might draw on the LWCF. The planning process begins with an emphasis on systematic inventories to examine the entire range of valuable resources and identify the most outstanding examples of natural, cultural, and recreational areas. The process establishe two levels of study for specific sites. First, a Reconnaissance Survey is conducted to collect basis information about characteristics and resources. This data is reviewed by the LPG to determine if the area merits Federal attention. If it does appear to meet the standards, which consider resource quality, integrity, threats of adverse impacts, and other factors, a more detailed study of protection and management alternatives will be conducted.

The analysis of alternatives will consider how existing Federal, State or local planning and regulatory authorities could be used to protect the area. Zoning, permit requirements, and other police power techniques discussed above will be explored. Alternatives to acquisition of full fee including purchase of easements, and timber, mineral, water, or other rights will be considered. The study also will examine some creative acquisition methods including the use of tax incentives to encourage donations, exchanges, or bargain sales. The findings of the study will provide the basis for recommendations on appropriate Federal, State, or local assignments of responsibility for management and, if necessary, new legislative authority from Congress.

The LPG also has adopted a policy statement to guide the new area study process. The policy emphasizes identifying important resources and assuring their protection through means other than direct Federal acquisition. The policy provides general direction on what type of areas will be studied, how priorities will be established, and what alternative protection techniques will be considered. It also addresses schedules for implementing adopted protection strategies in newly authorized areas.

The policies and planning procedures adopted by the LPG will help meet the recreation and conservation challenges of the 1980's. In the past the Federal acquisition program generally emphasized large relatively pristine areas with outstanding natural values. Looking to the future, more attention will be directed to areas closer to population concentrations. Many of the areas currently under consideration possess a variety of natural, cultural, and recreational resources on land with important economic values. For these complex landscapes, direct Federal land acquisition and management may be inappropriate as well as financially impractical.

The Area of National Concern (ANC) concept is one new approach to combining a variety of alternatives to fee-simple acquisition in an effort to protect natural resources and provide recreational opportunities. Greenline Parks, Preserves, Reserves, the "Cape Cod Formula", and other terms have been used previously to describe variations on the ANC concept. Although titles vary, the basic idea is to build a partnership where the Federal government provides a limited amount of financial and technical assistance to support State and local leadership in planning and managing an area of importance to the nation as a whole. Within the boundaries of the ANC some land would be acquired by Federal or State agencies but most of the area would be protected by a combination of zoning, easements, regulatory authorities, and other alternatives to fee simple purchase. Private ownership and compatible economic activities such as farming would continue. Grant programs, purchase lease-back or sell-back arrangements, and other incentives could encourage current residents to provide tourist facilities and other recreational services.

Several existing national areas incorporate some elements of the ANC concept. For example, the Sawtooth and Whiskytown-Shasta-Trinity NRA's have used easements and zoning to reduce the need for outright purchase. The Wild and Scenic River System emphasizes limited purchase of access points and reliance on easements or zoning along the shoreline to protect the most important recreational values of the river. Cape Cod, Fire Island, and Sleeping Bear Dunes provide additional examples of national areas with continued private ownership subject to zoning protection. At the State level, New York's Adirondack Park provides one model of how public and private ownership can be managed within a single boundary.

The most complete example of the ANC concept at work is now unfolding in the New Jersey Pinelands. In 1978 Congress authorized the Pinelands National Reserve encompassing one million acres in the Northeast's most industrialized state. The Pinelands offer a unique combination of fascinating plants, important wildlife habitats, valuable supplies of pure water, numerous recreational opportunities, and a significant local economy based largely on compatible agricultural uses.

The Pinelands ecosystem is being threatened by encroaching residential development fueled in part by growth around Atlantic City. The protection strategy calls for a comprehensive management plan to be developed by a 15 member commission including Federal, State and local representation.

The Plan must be completed within 18 months and forwarded to the Secreatry of the Interior for approval. While the plan is being developed the Act provides for "emergency" acquisition of lands with critical ecological values which are in immediate danger of being destroyed. Once the plan is approved, the Act authorizes grants for land acquisition by the State. However, the plan must require that State and local police powers be used to the maximum extent practicable to regulate the use of land and water resources. Only $23 million of Federal money is authorized for land acquisition in the 1 million acres, supporting the point that State and local regulations will be the most important implementing tools.

The ANC approach cannot replace the Federal land acquisition program, but it can provide a workable alternative in many new areas proposed for study. Lowell, Massachusetts, the Santa Monica Mountains in California, and Jean Lafitte in Louisiana are the most recent examples of the ANC concept already being applied around a core of land to be managed as a national park, recreational area, or historical preserve.

In the years ahead, we can expect more ANC's to be established where private ownership and public interests in natural, cultural and recreational values can be managed effectively without exclusive reliance on Federal acquisition. HCRS and other members of the LPG will be continuing to support this trend toward finding more creative solutions to conservation and recreation challenges.

SOCIAL-PSYCHOLOGICAL IMPLICATIONS FOR RECREATION RESOURCE PLANNING[1]

Hardeep S. Bhullar
Chairman and Associate Professor
Department of Recreation and Park Administration
University of Missouri-Columbia

Alan R. Everson
Associate Professor
School of Forest Resources
University of Missouri-Columbia

Scout L. Gunn
Associate Professor
Department of Health, Physical Education and Recreation
Oklahoma State University, Stillwater

INTRODUCTION

Many claims have been made concerning the use/effect relationship between recreation d leisure activity, and the acquisition of ality living. Studies have investigated e utility, quality, and quantity of rec- ation facilities. Studies of programs, adership, members, and general classifi- tions of users have also been conducted.

If leisure participation is need-fulfil- ng behavior that is learned, motivated by and edicated upon the individual's personality, en we need to study the relationships tween this behavior and the needs fulfilled it. Works of several individuals show that ends are developing in attempt to further derstand recreative behaviors of the partici- nt populations. Researchers such as Hendee, iver, Brown, Moss and Gray are beginning to plore user traits and activity relatedness.

This paper is a presentation of results, d discussions, of three studies conducted explore possible relationships between rticipation in selected outdoor leisure tivities and fifteen personality variables volunteer subjects. Specially designed Outdoor Recreation Activity Questionaires were used to measure the rates of participation. The Edwards Personal Preference Schedule and the Adjective Check List were used to measure personality variables.

The three studies were conducted with subjects from the Appalachian State University in North Carolina, the University of Georgia, and Mississippi State University. The studies in Georgia and Mississippi included white and black, male and female college students. These studies offer three separate opportunities to examine the effect of clustering outdoor recreation activities, and the clustering of personality traits based on the characteristics of respondents. The studies show several similarities in the needs that are being met by activities. There are also similarities in the order of activity clusters and need clusters, but different techniques were employed and the studies' results are not fully comparable.

METHODS

The study involving subjects from North Carolina used the Adjective Check List (ACL) to measure the personality traits and the Outdoor Recreation Participation Questionnaire

---

[1] For presentation at the Outdoor creation Trends Symposium New England Center, rham, New Hampshire, April 1980.

(QRPQ) to measure outdoor leisure participation. Volunteer subjects for the studies in Mississippi and Georgia were administered similar instruments -- the Edwards Personal Preference Schedule (EPPS) and the Outdoor Recreation Activity Questionnaire (QRAQ). In all cases, participation rates and the needs were "factor analyzed" to obtain clusters of outdoor recreation activities and personality traits; this procedure clusters entities according to their similarities. A matrix of interpersonal similarity coefficients is computed by the program, and this matrix is "searched" for patterns of similarities (Cattell, 1966).

For the Mississippi and North Carolina studies, Canonical Correlatinal Analysis was used to determine if a relationship existed between the two variable sets - activity clusters and trait clusters. This procedure provided an indicator of the maximum relationship that existed between the two variable sets, and also calculated the relative contribution of each variable to the relationship.

RESULTS AND DISCUSSION

A. Clusters

It is postulated that there is a measurable interrelationship between motives or need-states and leisure activities. It is suggested that a particular activity may be related to several needs, but is more likely to serve similar needs for similar people. Also several activities may be related to the same or similar needs of leisure resource users.

Activity clusters formed by Factor Analysis seemingly have much face validity, and they are correlated statistically. For example, in white males of the Georgia study (Table 1), Cluster 1 involves three walking activities -- hiking, nature walks, and walking for pleasure. Cluster 3 is water based -- boating, water skiing and sunbathing. Cluster 5 is composed of the typical "sportsman's" activities -- camping, fishing, hunting, target shooting and archery. Similarly, activity cluster results are reported for black males and white females (Table 2,3,4).

TABLE 1

Activity and Need Relationship
for White Males (Georgia)

Activity Cluster	Activities	Need Cluster	Needs
1	Hiking Nature walks Walking for pleasure	I	(-) Order (+) Affiliation (+) Nurturance
2	Picnics Horseback riding Tennis Bicycling Sightseeing	II	(+) Intraception
3	Boating Skiing (water) Sunbathing	3	(-) Dominance (+) Abasement (-) Heterosexuality
4	Canoeing Skiing (snow) Cave exploring Mountain Climbing	4	(-) Achievement (-) Exhibition
5	Camping Fishing Hunting Target shooting Archery	5	(-) Succorance (+) Dominance (+) Change
6	Automobile riding	6	(-) Deference (+) Autonomy

TABLE 2

Activity Cluster and Need
Cluster Relationship (Mississippi)

Activity Cluster	Activities	Need Cluster	Needs
1	Boating, large reservoirs Horseback riding Swimming, lakes Motorbike, street Fishing, large reservoirs	1	(+) Affiliation (+) Nurturance (-) Aggression
2	Fishing, rivers Canoeing, rivers Hunting, small game Hunting, bird	2	(+) Achievement (+) Dominance (-) Succorance
3	Hiking Nature walks Walking for pleasure Sightseeing	3	(+) Heterosexuality (-) Abasement
4	Camping, trailer Canoeing, lakes & large reservoirs	4	(+) Order (-) Change
5	Fishing, lakes Boating, rivers Mountain climbing Sightseeing	5	(-) Nurturance (+) Intraception (+) Dominance

The North Carolina activity data divides into seven activity clusters (A1-A7) in table 5. Activity cluster one (A1) includes the following activities: sightseeing, walking for pleasure, attending outdoor social functions, automobile riding for pleasure, jogging, picnicking, and nature walks. A1 is referred to as the "Nature-Pleasure" cluster. Cluster A2 is comprised of the following activities: horseshoes, golf, touch football, softball or baseball, basketball, miniature golf, attending

TABLE 3

Activity Cluster and Need
Cluster Relationship (Mississippi)

White Females

Activity Cluster	Activities	Need Cluster	Needs
1	Swimming, rivers Sailing Scuba, sea	1	(+) Exhibition (-) Intraception
2	Boating, large reservoirs Motorbike, street Canoeing, large reservoir	2	(+) Order (+) Aggression (-) Affiliation
3	Canoeing, rivers Hunting, bow & arrow Snow skiing Scuba, lakes & reservoirs	3	(+) Exhibition (-) Intraception
4	Camping, trailer Bicycling Touch football	4	(+) Dominance (-) Abasement
5	Nature walks Walking for pleasure Sightseeing	5	(+) Succorance (-) Change (-) Autonomy

TABLE 4

Activity and Need Relationship
for White Females (Georgia)

Activity Cluster	Activities	Need Cluster	Needs
1	Horseback riding Attending outdoor sports Attending outdoor concerts, drama	1	(+) Order (-) Affiliation (-) Nurturance (+) Endurance
2	Hiking Nature walks Walking for pleasure	2	(+) Autonomy (+) Change
3	Boating Skiing (water) Sunbathing Automobile riding	3	(+) Deference (-) Autonomy (-) Aggression
4	Picnics Swimming Sightseeing	4	(-) Achievement (-) Succorance (-) Dominance (+) Abasement
5	Skiing (snow) Golf Target shooting	5	(-) Exhibition (+) Intraception (-) Heterosexuality

TABLE 5

Activity Clusters: Content and Identification

Cluster Number	Activity	Identification Factor
A1	Sightseeing Walking for pleasure Attending outdoor socials Automobile riding for pleasure Jogging Picnicing Nature walks	Nature-Pleasure
A2	Horseshoes Golf Touch football Softball or baseball Basketball Miniature golf Attending outdoor sporting events Tennis	Social Sports
A3	Fishing Hunting (small game) Target Shooting	Predator Sports
A4	Primitive camping Hiking (with packs) Horseback riding	Nature/Conqueror-Horses
A5	Bicycling Motorbike riding Attending outdoor concerts, drama	Bike-Concerts
A6	Swimming (lake, river ocean) Swimming (pool) Motorboating Water skiing Sunbathing	Water-Orientation
A7	Sledding or Tobogganing Snow skiing	Winter Sports

outdoor sporting events, and tennis; this cluster is primarily oriented toward "Social Sports". A3 is made up of fishing, hunting (small game), and target shooting, which is identified as "Predator Sports". Primitive camping, hiking (with packs), and horseback riding comprise the fourth activity cluster, A4. This cluster is referred to as "Nature/conqueror-Horses". Bicycling, motorbike riding, and attending outdoor concerts (drama) make up the fifth activity cluster, A5, which is identified by the key words "Bike-Concerts". A6 identifies "water-oriented" activities, and includes: swimming (lake, river, ocean), swimming (pool), motor boating, water skiing, and sunbathing. Sledding or tobogganing, and snow skiing, form the last activity cluster, A7, representing "Winter Sports".

Three clusters (T1-T3) were obtained for the fifteen personality traits (Table 6). T1 contains (+) achievement, (+) dominance, (+) endurance, (+) order, (+) intraception, (-) succorance, and (-) abasement. This cluster is discussed as the "Leadership-Organization" factor. Trait cluster T2 is made up of the following traits: (-) exhibition, (-) autonomy, (-) aggression, (+) abasement, (+) deference, and (-) dominance. This cluster is referred to as the "Subordination-Guilt" factor. (+) Nurturance, (+) affiliation, (+) heterosexuality, and (+) change comprise the third trait cluster, T3, and is identified as the "Socialization-Change" factor.

Results of the study on black males and females show that their needs are only a little different from those of white subjects; these differences are accounted for by such factors as culture, opportunities to participate, availability of facilities and the location of residence. With the current trends toward narrowing social and cultural gaps between various ethnic and cultural groups, it is becoming imperative that leisure facilities be planned while taking into consideration all of these groups.

TABLE 6

Trait Clusters: Content and Identification

Cluster Number	Traits	(+ or -)	Identification Factor
T1	Achievement	(+)	Leadership-Organization
	Dominance	(+)	
	Endurance	(+)	
	Order	(+)	
	Intraception	(+)	
	Succorance	(-)	
	Abasement	(-)	
T2	Exhibition	(-)	Subordination-Guilt
	Autonomy	(-)	
	Aggression	(-)	
	Abasement	(+)	
	Deference	(+)	
	Dominance	(-)	
T3	Nuturance	(+)	Socialization-Change
	Affiliation	(+)	
	Heterosexuality	(+)	
	Change	(+)	

Results of these studies indicate that blacks do participate in activities which were traditionally considered for whites only.

B. Correlations

For the North Carolina data a Canonical Correlation Analysis was made, in addition to clustering, to determine if a relationship existed between the two variable sets -- activitiy clusters and trait cluster. Analysis shows all of the activity clusters except one (A4) to be significantly correlated with the set of trait variables at the .01 level. These correlations are the major contribution of this paper to outdoor recreation trend researchers.

A1 Nature-Pleasure. The "Nature-Pleasure" oriented activities (A1) are most participated in by individuals scoring high in the "Socialization-Change" cluster (T3). These activities are enjoyed by both sexes. The point is that the desire for social contact within an outdoor setting seems to be the primary motivation for activity, rather than participation in an object-oriented skill. Lack of structure and competitiveness characterizes both the activities and the users. Lack of participation on the part of individuals scoring high in T2 is somewhat surprising, in that activities such as sighseeing, walking for pleasure, and nature walks can be isolated experiences. Perhaps the crowding effect of users upon resources has paid its toll on the participation level of introverted users. Then again, perhaps the "Subordination-Guilt" oriented individual has never been a participator.

A2 Social Sports. Participants in "Social Sports" (A2) demonstrate the same trait orientation as participants in A1. Competition is more of a factor in A2, but the socializing characteristic is still evident. Once again, introverted individuals do not participate in social sports. The lack of any correlation with extroverted individuals suggests that participation by these individuals is neither significantly present nor absent. The popularity of activities enjoyed by both sexes is of growing importance. Perhaps the current drive for "equality" is evident in the correlation of these activities and the related needs.

A3 Predator Sports. The more dominant and aggressive traits evidenced in T1 were significantly correlated to A3. This supports Moss' contention that hunters and fishermen are more traditional, dogmatic, and rigid. The "predator-prey" or "lording over" motivation is apparent in this correlation. Quite naturally, then, the negative effect of T2 and A3 is evident. Perhaps it can be concluded that these more rigid individuals do not appreciate the intrusion of other people.

A4 Nature Conqueror/Horses. The relationship between A4 and the set of trait variables was not significant at the .01 level, but in the step-wise analysis it was noted that "Subordination-Guilt" oriented individuals tended not to participate in primitive camping, hiking (with packs), and horseback riding.

A5 Bike/Concerts. Specific personality traits positively correlated with A5 were not obvious, though a negative correlation with T2 was reported. It was thus assumed that the introverted "Subordination-Guilt" oriented persons did not participate in faddish activies such as bicycling, motor bike riding, and tdoor concerts (perhaps "Rock Festivals"). e lack of a specific, positive identity of lividuals participating in these activities y be due to the faddishness of the activities.

A6 Water Oriented. Water oriented activies were most participated in by those scoring gh in T3 and least participated in by those oring high in T2. Once again it becomes parent that the introverted "Subordinationilt" oriented individual is not active in tdoor activities. The question of reaching ese individuals is pertinent to recreology. rticipation in water activities (other than shing) seemed to be mostly inspired by the cial contact involved rather than the goal individual accomplishment. Most certainly, npetition in water activities is important, to the leisure resource planner it is a dominant factor.

A7 Winter Sports. The correlation of all it clusters to winter sports indicates t these activities are somehow both comitive and socializing in nature. Perhaps e detailed study concentrated on outdoor ter activities would yield a more precise surement of activity-trait correlations.

Overview, A1-A7. An overall view of the ationship of personality traits or needs to door leisure activities seemed to indicate trong socializing motivation in most ivities. Introverted personalities have tle opportunity for involvement. It is oming increasingly likely that aggressive, l-oriented, dogmatic individuals are being wded in their participation and forced to promise in their activity.

IMPLICATIONS

Perhaps by now some of the practical lications of this type of research are parent. Personality traits and activity sters are the real units of measure of door recreation. If we are to be successful providing the best possible outdoor recreon experiences to the public, we must erstand (1) which activities are similar dissimilar, and (2) what users are actually ing out of their recreation. It is not ugh to simply offer "picnicking" and count users.

How do we use the information? Perhaps we conclude that several related activities ld be offered at the same recreation -- cater to a given kind of user. Results est that some activities -- actually s -- need to be insulated from others; it ikely that where dissimilar activities are aposed, a lessened recreation experience occurs by a sort of conflict which has not been apparent. Alternately, perhaps we will want to be dollar efficient, and not offer duplicative activities. Or perhaps we should spread like activities at several locations to give users a variety of settings from which to chose for recreation. Maybe we can save money by providing an activity that costs less but meets the desired need.

Once we know what "rewards" people are seeking, managers can not only respond to current users but also to persons who are not currently recreating because what they need is not available. Planners can devise recreation settings and perhaps facilities and activities that deliver desired rewards, i.e. respond to groups with known personality traits. They can devise, emphasize, and perhaps even create improved products.

However, we make no claims at this point about whether people are consistent in what rewards they seek, or whether they seek different experiences at different stages in their life, or even from day to day. Neither do we know the effect of one member in a group on others. Do a group of teenagers exhibit needs that are the average of member's individual needs, or is a range needed at a recreation site? Does a family have a complex set of requirements, and does that set of requirements depend on which members are present, or their age, and so forth? Clearly, there are many things we do not know.

This research offers a "window" to greater understanding. Through it we can learn to respond better to our publics. Through it we can more efficiently plan, acquire, develop and even maintain and operate our outdoor recreation areas. Four problems must be overcome to "enlarge the window". First, more research of this sort needs to be conducted to expand, clarify and confirm findings. Second, we must learn how to apply this new knowledge throughout all aspects of outdoor recreation management. Third, how will this information be disseminated; how will we get recreation management to accept and apply these findings. Fourth, and finally, is there an ethical problem: does broad collection of this kind of information involve invasion of privacy? Beyond that, does it put us in a position of having power over our constituents -- of molding and shaping them to be what the managers or agency or firm wants. Let us hope these problems can be overcome.

TABLE 7

Relationship Between Activity Clusters and Trait Clusters

Activity Clusters		Trait Clusters
A1 Nature-Pleasure		T3 Socialization-Change
A2 Social Sports		T3 Socialization-Change
A3 Predator Sports		T1 Leadership-Organization
A4 Nature/Conqueror-Horses	(-)	T2 Subordination-Guilt
A5 Bike-Concerts	(-)	T2 Subordination-Guilt
A6 Water-Orientation		T2 Subordination-Guilt
A7 Winter Sports		T1 Leadership-Organization T2 Subordination-Guilt T3 Socialization-Change

REFERENCES

Bhullar, H.S., 1970. Personality and Outdoor Recreation: A study of outdoor recreation as need fulfilling behavior in Whites and Blacks, Unpublished Ph.D. dissertation, University of Georgia.

Cattell, R.B., 1966. The Taxonomic Recognition of Types and Functional Emergents, *Handbook of Multi-variate Experimental Psychology*, Chicago: Rand McNally and Company.

Driver, B.L., and Brown, P.J., 1975. A socio-pyschological definition of recreation demand, with implications for recreation resource planning. Appendix A. *In Assessing Demand for Outdoor Recreation* Washington, D.C.: National Academy of Science. Reprinted by the Bureau of Outdoor Recreation, USDI.

Edwards, A.L., 1959. Edwards Personal Preference Schedule Manual, New York: Psychological Corporation.

Everson, A.R., 1978. Standards in State Comprehensive Outdoor Recreation Planning: A Methodological Study, Unpublished Ph.D. dissertation, Texas A&M.

Gunn, S.L., 1972. A comparative study of selected personality traits in college students and their participation in selected outdoor recreational activities, Unpublished Ph.D. dissertation, University of Georgia.

Gray, D.E., 1980. What is this thing called recreation? *Parks and Recreation*, Vol. 15, No. 3.

Hendee, J.C., 1971. Sociology and applied leisure research. *Pacific Sociological Review*, Vol. 14, No. 3, 306-68.

Moss, W.T., and Lamphear, S.C., 1970. Substitutability of recreational activities in meeting stated needs and drives of the visitor. *Environmental Education*, Vol. 1, No. 4, 129-31.

AUTOMATIC, TIME-INTERVAL TRAFFIC COUNTS FOR RECREATION AREA MANAGEMENT PLANNING[1]

D. L. Erickson, Assistant Professor
Department of Forestry
University of Kentucky
Lexington, KY

C. J. Liu, Assistant Professor
Department of Forestry
University of Kentucky
Lexington, KY

H. K. Cordell, Project Leader
Forest Recreation Research
Southeastern Forest Experiment Station
U.S. Forest Service
Athens, GA

Abstract.--Automatic, time-interval recorders were used to count directional vehicular traffic on a multiple entry/exit road network in the Red River Gorge Geological Area, Daniel Boone National Forest. Hourly counts of entering and exiting traffic differed according to recorder location, but an aggregated distribution showed a delayed peak in exiting traffic thought to be typical of recreation areas. The proportions of hourly entering and exiting traffic and weekend and weekday traffic varied among locations. An exceptionally high weekend use was related to occurrence of the autumn color season. Subsequently, there was a general down-trend in weekend use. Implications of traffic data for the allocation of resources to information, interpretation, and enforcement programs in the Red River Gorge area are discussed.

INTRODUCTION

Traffic counts have been used as an in-
tor variable for recreation use estimation
orest lands and developed recreation sites
es 1971). With few exceptions, axle counts,
pposed to vehicle counts, have been used as
indicator variable in regression models.
cally, recorders are placed on two-way,
le-entry roads leading to developed or dis-
ed recreation areas. Usually, traffic recorders must be hand-read at selected time intervals by field personnel. This paper reports the use of dual-input, time-interval recorders to record hourly and daily variations in traffic flow in forest areas with multiple entry/exit points. These recorders were used in a recreation use estimation study on the Red River Gorge Geological Area on the Daniel Boone National Forest.

Data on time variation in traffic counts have implications for the development of recreation area management plans. Recreation planning can be viewed as a production process where management and site resources and human use are managed to produce recreation experiences and ultimately, human benefits (Driver and Brown 1975). It is important to know the total amount and the hourly and daily patterns of recreation use because of their impact on recreation experiences, the resource base, and management loading. Heavy amounts of recreation use can cause displacement of dissatisfied users in both time and space. It can also increase the probability of traffic accidents, forest fires, user conficts, and unacceptable public behavior, as well as resource impacts such as trail and campground deterioration. Information about the distribution of recreation use is important for assigning of personnel and other management resources to road and trail patrols, interpretive activities, maintenance work loads, requests for traffic control, and justification for requests for personnel overtime. All of these are management activities which can contribute directly to enhancing recreational experiences.

---

[1] Paper presented at the National Outdoor
eation Trends Sympoisium, Durham, NH, April
3, 1980.

METHODS

In the summer of 1979, a recreation use study was inititated in the Red River Gorge Geological Area. The Gorge is a 25,750 acre area located in the Stanton District of the Daniel Boone National Forest. Dual-input traffic recorders were located at six locations along roads near the Gorge boundary (Fig. 1). These locations are Pine Ridge, Koomer Ridge, Tunnel Ridge Road, Nada Tunnel, Road 23, and CCC Camp. At each site, inductive loops were installed to record directional traffic, and recorders were set to print and punch traffic counts at 15-minute intervals during the 4-month study period, August 1 to December 2, 1979. Data were punched onto 8-channel paper tape and translated to computer cards. Data were aggregated into hourly and daily counts and plotted.

RESULTS

Although recorders were installed at six locations, the traffic data for two locations--Koomer Ridge and Tunnel Ridge--were excluded from data analysis. These recorders were located on single-entry roads where vehicles entered and exited the same point. These data have no effect on the total traffic load of the multiple entry/exit road network.

Graphs of the number of vehicles plotted in relation to hour of the day provide information on hourly patterns of vehicular traffic at specific locations in the Gorge area. Pine ridge, located near the Mountain Parkway, appears to be more important as an exit point for vehicular travel (Figure 2). More vehicles are exiting than entering at this point. There are approximately equal amounts of traffic entering and exiting this point unti about 2 p.m. when exiting traffic begins to exceed entering traffic. Exiting traffic peaks at 4 p.m. Also characteristic of this point is the high volume of exiting traffic occurring in a narrow time span and a lower volume of entering traffic in a wider time span.

In contrast to Pine Ridge, Nada Tunnel has more entering than exiting traffic (Figure 3). The curve of the entering traffic reaches its summit at 4 p.m. and then declines rapidly. Compared with this curve, the exiting traffic curve climbs at a slower rate. It reaches the highest point about 4 p.m. and then follows a gentle decline until 6 p.m. Thereafter, the curve drops rapidly similar to the entering traffic curve. We suspect that most of the vehicles that depar between 2 and 8 p.m. are day users of the Gorge area.

In comparison with Pine Ridge and Nada Tunnel, CCC Camp has a different traffic pat tern. There are about equal amounts of ente ing and exiting traffic at all hours of the day (Figure 4). These curves depict traffic patterns revealing heavy local use.

To obtain an understanding of hourly traffic for the entire gorge area, data were aggregated for Pine Ridge, Nada Tunnel, CCC Camp, and Road 23 and then plotted (Figure 5 There is a more rapid increase in the enteri than exiting traffic until about 2 p.m. At that time, the rate of exiting traffic begin to accelerate. Note, again, the delay in th peaking of exiting in relation to entering traffic. While we recognize that some residential traffic is included in this plot, we believe that it is typical for a multiple entry/exit forest area such as the Red River Gorge area.

Figure 6 shows the entering traffic for Pine Ridge and CCC Camp throughout the study period. At Pine Ridge, there was a great deal of difference between weekends and week days which suggests heavier recreational tra fic entering this point in comparison to loc residential traffic. CCC Camp, on the other hand, does not show much variation in weekda to weekend traffic suggesting proportionatel more residential/commercial traffic.

Figure 7 shows the incoming and exiting traffic for the aggregate of Pine Ridge, Nad Tunnel, Road 23, and CCC Camp. Note the dif ferences between weekend and weekday traffic. Weekend traffic is much heavier than weekday traffic which is not surprising. Many studi have reported such variations in traffic pat- terns at recreation use areas--and researche

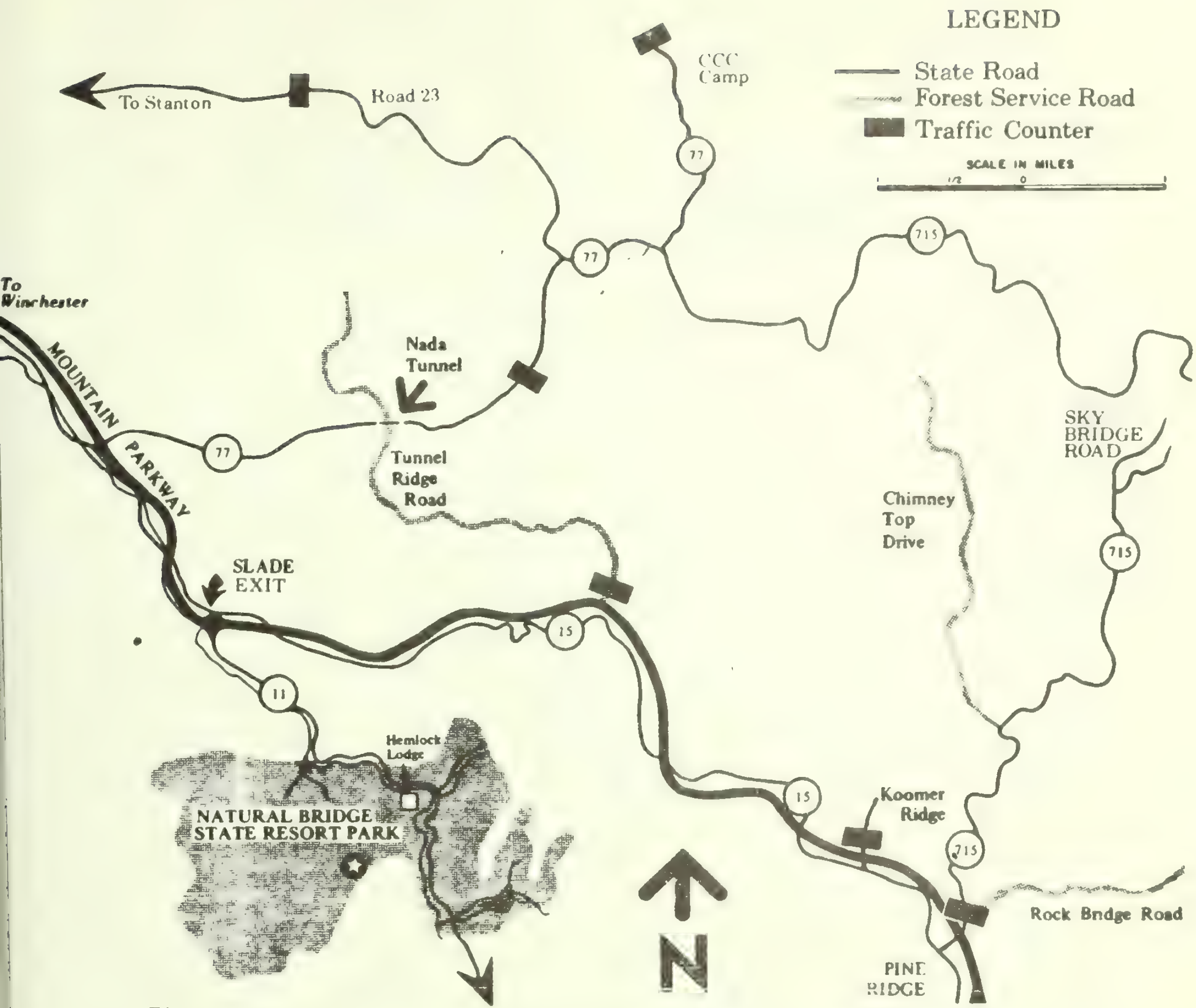


Figure 1. Locations of six dual-imput traffic recorders near Gorge boundary.

used these data to stratify the sample in eation use studies.

Note also that some of the weekend days considerably larger volumes of traffic. highest one is a weekend of peak fall r. Another weekend is a holiday, labor weekend. In Figure 7, there appears to downward trend in traffic after the peak color weekend. Although there is some ation from weekend to weekend, this ation suggests that traffic levels may be ted to local weather. Hendee et. al. 6) reported that low levels of use were ciated with adverse weather.

IMPLICATIONS

This study reports daily and hourly fluc-ons in traffic counts in the Red River area. To make suggestions about the im-tions for recreation management planning requires three assumptions. First, there are small variations in the proportion of recreational traffic within weekend and weekday strata. To the extent that there is variation, traffic patterns will not be valid indicators of volumes of recreational traffic in the Gorge area. A second assumption is that that proportion of recreation traffic does not vary significantly at each traffic counter location over a short period of time. A third assumption is that accurate directional traffic counts can be made. Our calculations show a traffic count error of 3 percent per site per day. We believe that the major cause of this counting error was not a malfunction of traffic recorders, but rather a double count, one for each direction, resulting from vehicles traveling down the center of the road. A procedure for eliminating directional traffic counting error has been developed (Erickson, in press).

The data presented above have a number of

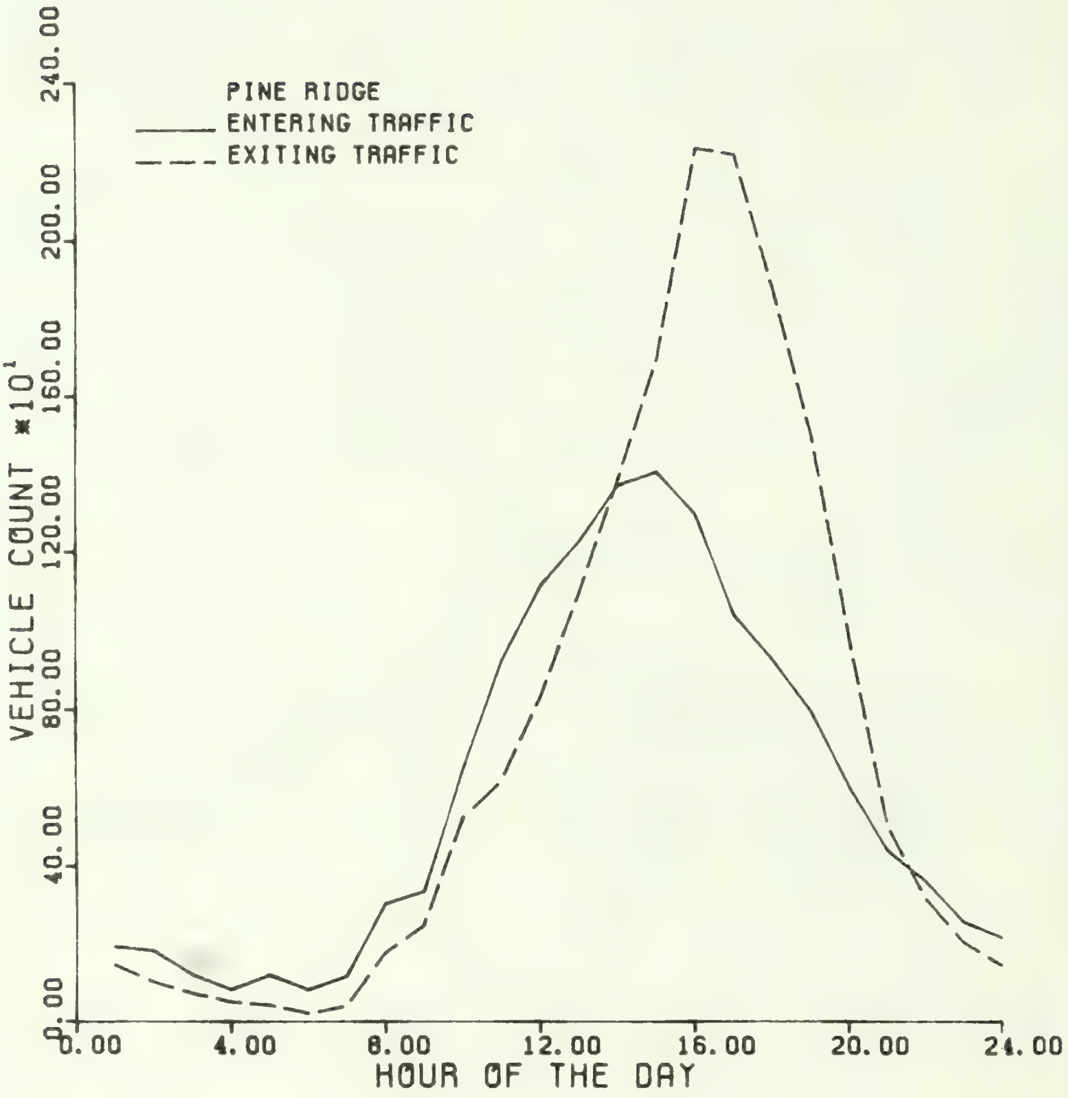


Figure 2.--Hourly entering and exiting vehicular traffic between August 1 and December 2, 1979 at Pine Ridge.

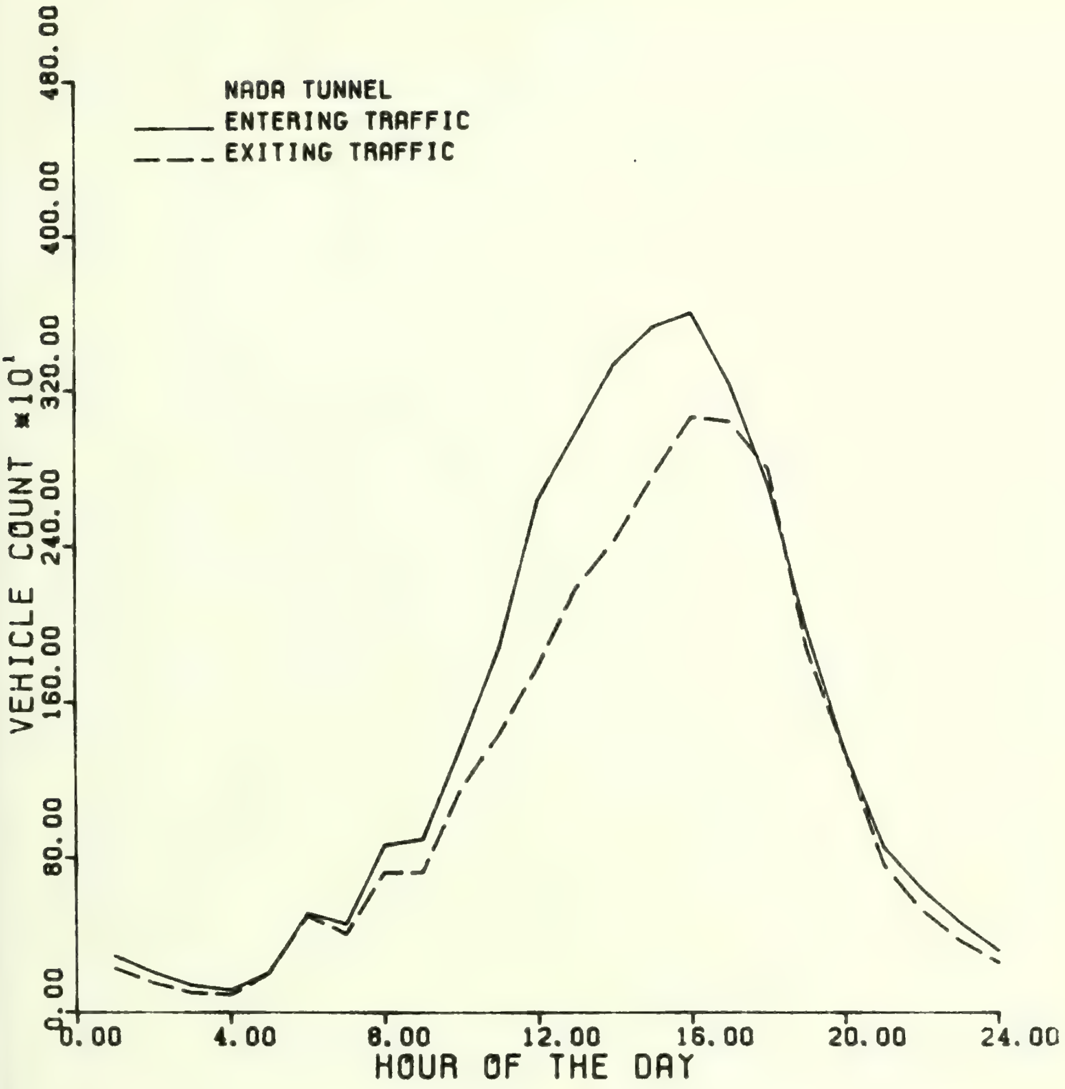


Figure 3.--Hourly entering and exiting vehicular traffic between August 1 and December 2, 1979 at Nada Tunnel.

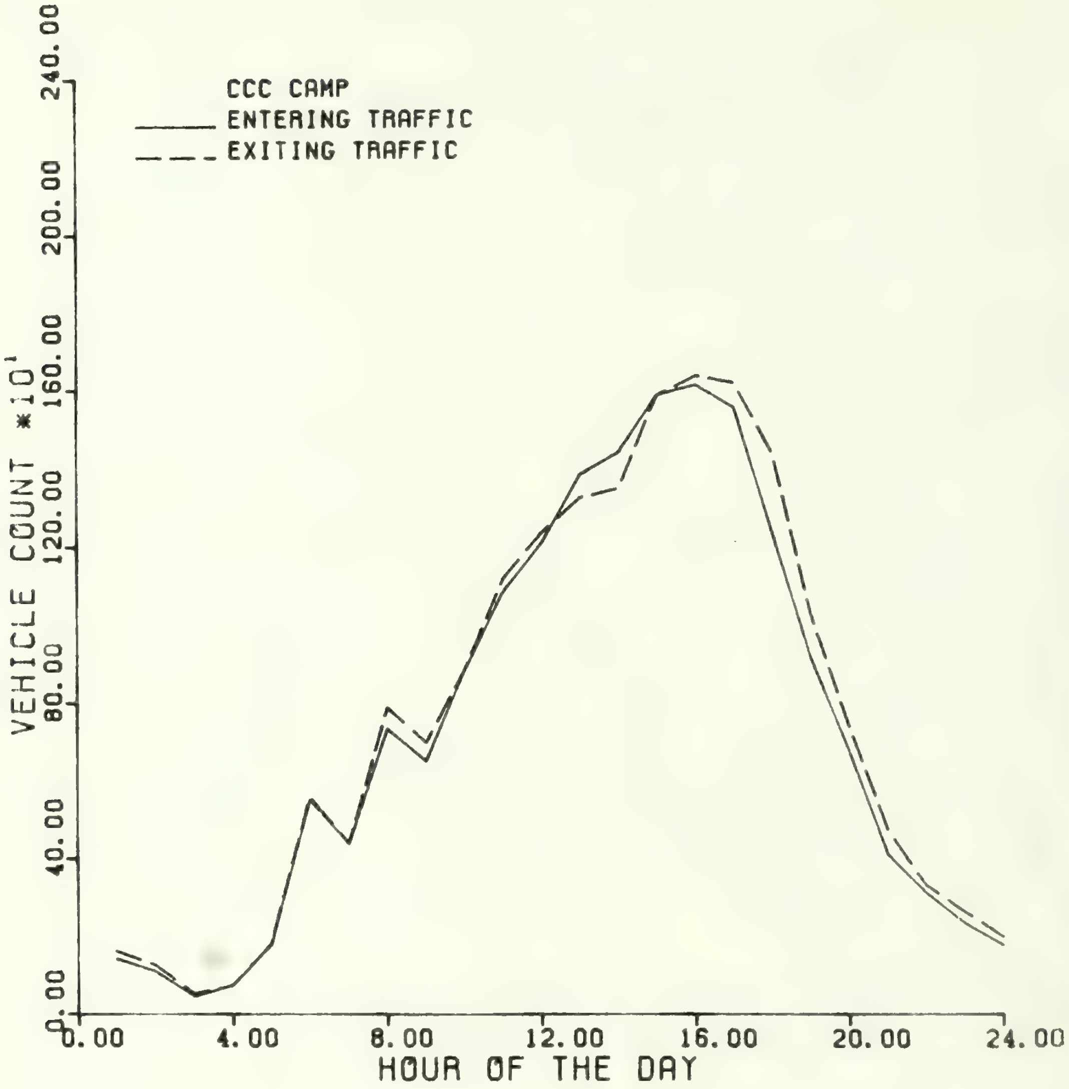


Figure 4.--Hourly entering and exiting vehicular traffic between August 1 and December 2, 1979 at CCC Camp.

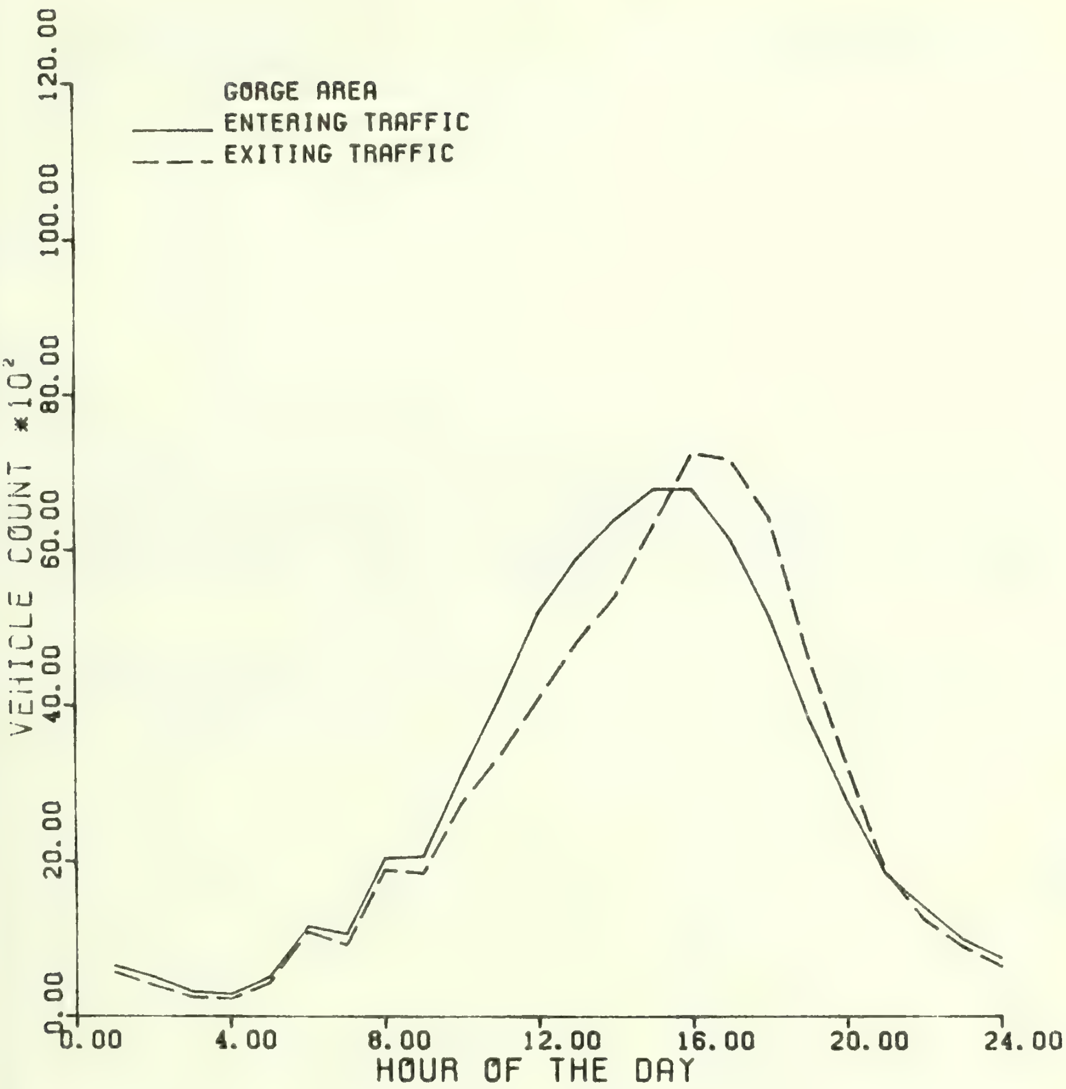


Figure 5.--Aggregated hourly entering and exiting vehicular traffic between August 1 and December 2, 1979 for four locations in the Red River Gorge Area.

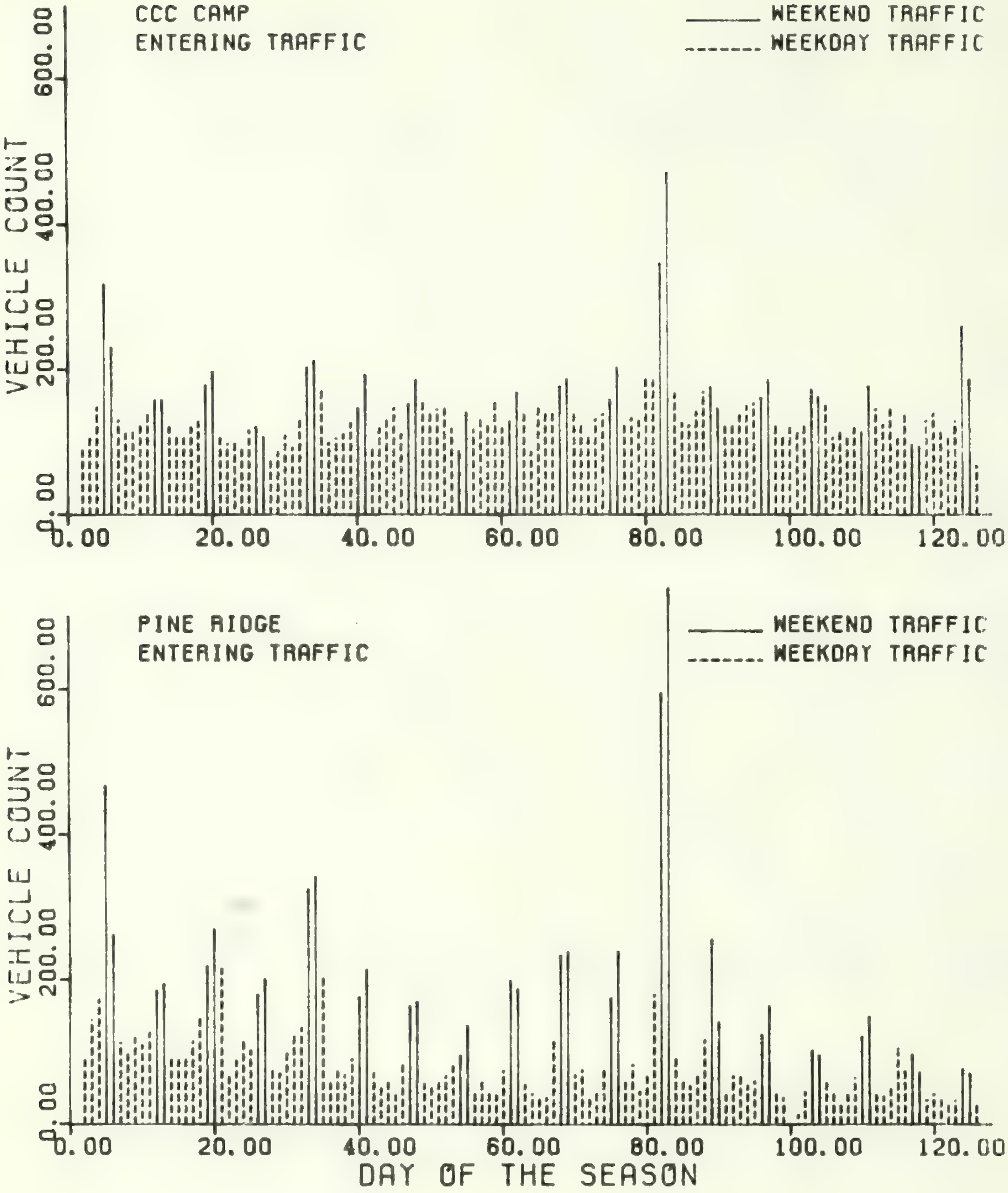
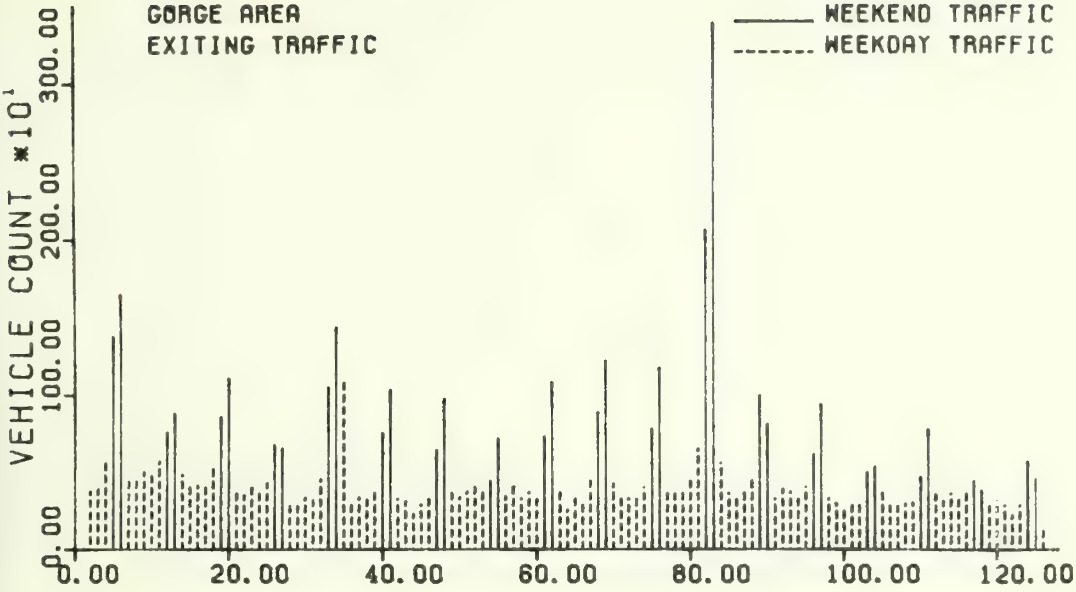


Figure 6.--Daily distribution of entering vehicular traffic between August 1 and December 2, 1979 at two Red River Gorge entry points.



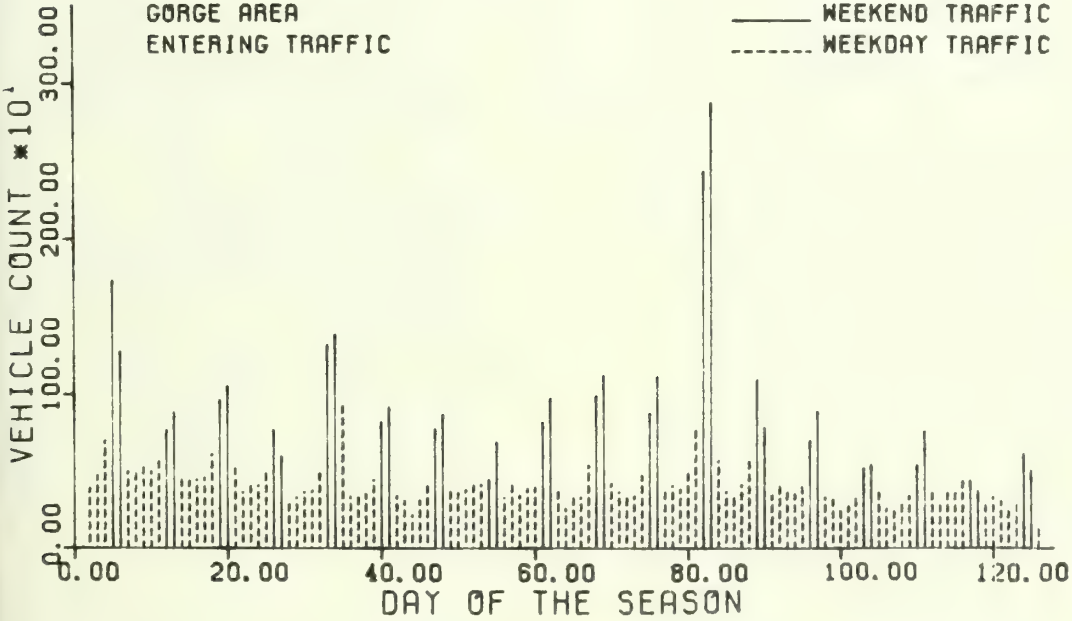


Figure 7.--Aggregated daily entering and exiting vehicular traffic between August 1 and December 2, 1979, for four locations in the Red River Gorge Area.

implications for recreation management planning. Our data suggest that certain roads are used more heavily as entry points into the Gorge area, e.g., Nada Tunnel, while others are used more heavily as exit points, e.g., Pine Ridge. Based on comments received during the study period, people are not knowledgeable about the kinds of recreational opportunities in the Gorge area, and are not informed about the geological significance of it. Given the heavier entering traffic at Nada Tunnel, it would be effective to locate information/interpretive media at this location. On weekends, it may be desirable to locate staff to both control traffic at the Tunnel and to hand out a brochure for a self-guided auto tour (Sharpe, 1976) or for stimulating use dispersal away from crowded sites. Nada Tunnel is a single vehicle passage through the mountain. As a result, traffic is slowed down considerably, particularly on weekends.

Pine Ridge had more exiting than entering traffic. At this point, it may be appropriate to locate a departure sign. In addition, it also might be desirable to locate a deposit box where people could place their suggestions for improving the area.

The greatest need for road or trail patrols would appear to be from 10 a.m. to 4 p.m. since most of the traffic is either entering or exiting from the Gorge area. After 4 p.m., entering and exiting traffic decreases at a rapid rate. This would appear to be an appropriate time to contact campers to see if they have problems. This might also be an appropriate time to conduct an interpretive program.

Many of the vandalistic acts that occur in forest areas occur at night, and traffic counts may be an indicator of these acts--even recorders are subject to tampering. Examination of traffic records for days and nights when vandalism has occurred may help identify most likely times of occurrence and from where those committing the vandalistic acts may have entered the system.

From a management planning standpoint, it is necessary to have a firm rationale for allocating management personnel and other resources. Obviously traffic in the Gorge area is higher on weekends, suggesting that more personnel should be allocated to these days. But among weekends, use is highly variable and the specific number of personnel needed must be decided on the basis of expected visitor load. An examination of vehicular loading for one year should be useful for determining personnel needs for specific weekends and other periods for several succeeding years. For weekends that are known to have high use levels, such as holidays or weekends at the peak of the fall color season, additional temporary personnel might be hired or reassigned to assis in visitor management including interpretati and enforcement.

Traffic counts such as recorded during 1979 for the Red River Gorge Area should hav use for area management planning for a few years after the study period. Perhaps equal important, however, are insights that might gained by 3- to 4-year repeat measures of traffic periodicity and patterns. Noticeabl changes in either hourly or daily pattern of use could indicate evolving changes in these patterns or in the type of users. Forest re reation management is greatly in need of suc indicators of change so that evolution of us patterns can be detected rapidly.

In summary, hourly, daily and seasonal traffic flow records seem to be useful mana ment and program scheduling tools. There is much we do not know about interpreting traff flows, but further research and management application should teach us a great deal.

LITERATURE CITED

Driver, B.L. and P.J. Brown. 1975. A soci psychological definition of recreation demand, with implications for recreati resource planning. pp. 64-88. IN Assessing demand for outdoor recreatio National Academy of Sciences, Washingt D.C. 123 p.

Erickson, D.L. In Press. Use of traffic recorders in dispersed recreation use estimation. Southeastern Forest Exper ment Station, U.S. Forest Service, Asheville, N.C.

Hendee, J.C., M.L. Hogans, and R.W. Koch. 1976. Dispersed recreation on three road systems in Washington and Oregon: First year data. USDA Forest Service Research Note PNW-280, Pacific Northwest Forest and Range Experiment Stati Portland, Oregon. 21 p.

James, G.A. 1971. Inventorying recreation use, pp. 78-95. IN Recreation sympos proceedings. Northeastern Forest Expe ment Station, U.S. Forest Service, Upp Darby, Pa. 211 p.

Sharpe, G.W. 1976. Interpreting the envir ment. John Wiley & Sons., New York. 566 p.

CROSS-COUNTRY SKIING TREND DATA: PLANNING FOR PARTICIPANT NEEDS[1]

Floyd L. Newby
Associate Professor
School of Forest Resources
University of Maine
Orono, ME

William D. Lilley
Extension Safety Specialist
School of Forest Resources
University of Maine
Orono, ME

As societal and economic pressures mold and alter patterns of human behavior, the outdoor recreation planner gazes into the milange of "trend data" developed to simplify his planning efforts and ....

Planning without empirical data on which to base sound decisions or solutions is somewhat akin to skydiving with a businessman's umbrella -- things go well until that final moment of truth when responsiveness to need must be evaluated. Planning for cross-country skiing has not enjoyed the security of a strong research base and only recently has there begun to emerge a somewhat accurate picture of the needs being expressed by the participants in this very rapidly growing winter activity. Where are the data coming from and are some data better than others? Do we hang our planner's hats on the economic approaches suggested by Keith (1980), the behavioral tact taken by Driver and Knopf (1977), the "opportunity spectrum" analysis of Ballman (1980), the social/psychological experience attribute studies by Haas, Driver and Brown (1980), or is it possible to simply reach into each process and extract those insights which can improve the planner's ability to eclectically synergize solutions to management problems?

In a recent Michigan study (Stynes 1980), interrelationships between winter recreation activities were explored in order to extract data which could be used in planning and forecasting management and user needs peculiar to winter recreation. Studies such as this can help facilitate a greater use of existing data from multiple sources rather than reinventing the wheel everytime new information is needed. Available data which suggest that people participate in a particular activity in a particular setting or circumstance because they expect to harvest a particular value or realize a particular and predictable recreation experience (Driver and Brown 1980), further suggest an almost mandatory analysis of multiple discipline research concepts as well as data. Such analysis will help bring trend data into focus for application to planning and management problems.

Some of the more promising research being done touches upon the imagery of certain activities and the motivational effects of common and unique images. The data of the USDA, Forest Service (1980) study of "Growth Potential of the Skier Market..." seem to add support to research conducted in the State of Maine over the past few winters. In particular, the concept of "psychological" (equates with the "experience opportunities" proposed by Driver and Tocher 1970, Hendee 1974, and Brown, et.al. 1979) is derived from specific imagery extracted through data analysis of the Maine studies (Newby and Lilley 1978, 1980; Newby and Warner 1980). It is hypothesized that much of the motivation for participation in a particular recreation activity is derived from the "images" held of that activity. This also ties in with the "experience opportunities" concept previously mentioned, but perhaps the more important aspect is that adopting the specific activity image becomes a stronger motivation than the actual participation in the activity. The attempts of the individual to adopt a specific activity image with its predictable behavior should serve as indicators of trends which can aid planners and managers in meeting participant needs.

The process of defining indicators of trends in such outdoor recreation activities as alpine skiing, nordic skiing and snowmobiling involves analyzing participation data and shifts in use patterns over time. Research conducted on these activities across the United States is producing the kinds of data needed to define trends which in turn are useful to planners and managers in both public and private sectors of winter recreation management.

---

[1] Paper prepared for the National Outdoor Recreation Trends Symposium, Durham, NH, April 0-23, 1980.

Trend Data For What?

To illustrate the kinds of trend data that might be useful to management, a study of cross-country skiers in Maine was conducted over a three year period. The last winter (1976-77) studied in depth provided some rather detailed data on use, preferences, and behavioral variations among cross-country skiers (a sample of 1042 skiers was obtained by questionnaire). Although only a small part of the data will be presented here, several interesting insights were developed concerning the cross-country skier.

The principal trend data to be addressed will deal first of all with cross-country skier use patterns, followed by some interactions with downhill skiing, and lastly with some trend relationship between the cross-country skier and snowmobiling. This data is presented primarily to show how trend data can be of assistance to management rather than to present it as a methodological analysis. Another methodology study is just too much of a temptation to become totally immersed in what LaPage (1971) once referred to as "research fogweed".

Cross-Country Skiing Use Trends in Maine

One measure of trends in an activity is the extent to which individuals participate or vary participation during the week and from year to year. Looking at Maine skiers we found that during the 1976-1977 cross-country skiing season, 77.4 percent of the questionnaire respondents skied on weekends and they averaged 14.1 days (Median = 12 days) of participation (Table 1). Interestingly, on weekdays, 60.6 percent of the respondents skied and they averaged 21.5 days (median = 15 days) of cross-country skiing (Table 2). These skiers averaged 2.6 hours of skiing on weekdays whereas the weekend skiers averaged 4.2 hours.

TABLE 1: Days of Cross-Country Participation on Weekends (Maximum = 39 days)

Number of Days	Percent of Respondents
1-5	18.0
6-10	31.2
11-15	15.3
16-20	19.0
21-25	5.2
26-30	6.5
>30	4.8
	100.0

TABLE 2: Days of Cross-Country Participation on Weekdays (Maximum = 82 days)

Number of Days	Percent of Respondents
1-5	18.6
6-10	21.2
11-15	13.2
16-20	13.9
21-25	6.0
26-30	6.5
31-35	3.3
36-40	3.2
41-45	1.6
46-50	3.6
51-55	0.5
56-60	3.0
>60	5.4
	100.0

These data suggest that use patterns for cross-country skiing are somewhat different than those of downhill skiing, e.g., cross-country skiing is better distributed throughout the week, therefore, weekend peaking may be less of a problem to management.

Looking at some additional trends might also provide the manager with added insights for planning use and opportunity management. For instance, the changes in the amount of skiing from year to year has signficance and demonstrates some definite trends. Among the cross-country skiers from the sample population who had skied before 1976-1977 (n=641), 55.9 percent said thay skied more in 1976-1977 than previous winters, 30.6 percent said they skied the same amount, and 13.6 percent stated that they skied less (Table 3).

TABLE 3: Number of Days of Participation by Comparison with Previous Use Patterns

Current vs. Previous Use	Median Number of Weekdays	Median Number of Weekend Days
Less	10	10
More	15	15
Same	15	14

Those who now ski more and those who ski the same amount as in previous years are essentially the same whereas, those who ski less do so by about 33% fewer days. Interest-

ly, those who were skiing less were younger
generally single (Table 4). Questions
ut future participation showed that more
n two-thirds (68.1%) of the respondents
nned to increase their next year's cross-
ntry skiing participation over that of
ir 1976-1977 activity levels. Approximately

TABLE 4: Age and Marital Status of Skiers by Use Comparisons

rrent vs. vious Use	Median Age Groups	Percent Single
Less	20-24	83.3
More	30-34	38.5
Same	30-34	32.2

rty percent planned to continue their pre-
t level of activity and only a little over
percent planned to reduce their number of
ing occasions.

If we look at the reasons for plans to
more or less compared to the 1976-1977
els, we see that new or increased interest
ounted for the shift to more skiing,
reas, those who planned to ski less gave
nged or changing opportunities as the
ncipal reason (Table 5). These same ba-
reasons were given for current shifts in
ivity levels. Seasonal snow conditions

E 5: Percentage of Respondents Indicating Specific Reasons for Planning to Cross-Country Ski More or Less

son r ge	% Indications Less Participation (n=22)	% Indications More Participation (n=685)
ging portunities	50.0	37.3
ging Interest Attitude	31.8	46.8
ged Skiing nditions	22.7	11.3
al teractions	----	13.1
r Reasons	9.1	11.1

little snow, poor due to warm weather,
snow, etc.) usually accounted for consi-
ble temporary shifts and were not really
rt of definable trends.

Another trend, which was noted in use
erns, surfaced as years of participation
ross-country skiing were compared with
re involvement. For example, more than
nty-five percent of the respondents who
skied for more than a year planned to in-
se their participation in subsequent years, at least during the early years of involvement, after which use levels tended to level off. Most changes in activity levels or frequency were most dynamic in the participation years, 2 to 5, and more particularly with regard to those who had cross-country skied for three years. Within this group, 36.7 percent planned to increase their cross-country skiing activity in subsequent years. The median years of involvement for those planning to ski less was four years, five years for those planning to ski the same amount, and four years for those planning to ski more.

Availability of opportunity is a principal motivator for change in activity levels and a variable often expressed was that of proximity to skiing opportunities.

Travel Distance Trends in Cross-Country Skiing

One of the major differences between the behavior of the cross-country skier and the downhill skier has to do with the opportunity to participate. Within this variable, the distance a skier must go to participate in his chosen winter recreation activity becomes a significant element. Many cross-country skiers state they have greater opportunity to participate because they don't have to travel very far to find a suitable area for skiing. In 1976-1977, study respondents traveled a median distance on weekdays of 1-5 miles and and 6-10 miles on weekend days (Table 6). The median longest trip taken by cross-country skiers to an area for skiing was 41-60 miles.

For 64.3 percent of the respondents who had skied before 1976-1977, the areas where they skied in 1976-1977 were the same distance as previous years. (Table 7). For those who traveled closer to home, the median longest trip was between 41 and 60 miles; those who traveled further from home went from 81 to 100 miles; and the median distance traveled by those having the same travel patterns, was from 41 to 60 miles (Table 8). The comparisons of distance traveled by longest skiing trips taken, weekday travel, and weekend travel with those who declared that they had skied closer, further, or the same distance from home also provide some insight into behavioral trends (Table 9). In most instances, the cross-country skier is either skiing closer to home or at least is not going further away to ski. The high percentages of individuals who ski within a relatively close distance to home regardless of the shifts in their declared travel distances, perhaps would suggest that planners and managers should consider both proximity and basic motivations as prime criteria in evaluating what and where opportunities should be provided.

Although shifts in the distance traveled

TABLE 6: Travel Distance (one way) on Weekdays, Weekends, and Longest Trip

Miles	Longest Trip (%)	Average Weekend Travel Distance	Average Weekday Travel Distance
Less than 1	6.5	18.4	39.9
1-5	10.9	23.5	38.8
6-10	11.1	18.6	11.7
11-20	9.5	10.1	4.7
21-40	8.3	6.8	2.1
41-60	7.4	6.3	(over 40) 2.8
61-80	8.3	4.9	100.0
81-100	8.6	2.9	
101-125	6.5	2.7	
126-150	5.9	(over 125) 5.8	
151-175	3.0	100.0	
176-200	3.7		
201-300	6.4		
>300	3.9		
	100.0		

TABLE 7: Travel Distance for Cross-Country Skiing in 1976-1977 Compared to Previous Winters

Relative Distance Traveled	% of Respondents (n=626)
Closer to Home	13.7
Further from Home	22.0
Same Distance from Home	64.3

TABLE 8: Travel Distances (one way) by Percent of Skiers for Relative Travel Patterns on Weekdays, Weekends, and Longest Trip Taken.

Travel Distance (Miles)	Percent of Respondents								
	Weekday Travel			Weekend Travel			Longest Trip		
	Closer	Further	Same	Closer	Further	Same	Closer	Further	Same
less than 1	43.3	45.6	39.7	23.8	10.6	19.9	5.9	2.9	6.5
1-5	38.8	32.2	39.9	26.2	22.0	22.9	9.4	3.6	10.6
6-10	10.4	8.7	12.3	23.8	16.7	19.9	8.2	9.5	12.6
11-20	4.5	6.8	3.8	6.0	10.6	9.0	10.6	4.4	10.6
21-40	----	1.9	2.8	7.1	9.8	6.6	11.8	5.1	8.1
41-60	(over 40) 3.0	4.8	1.5	3.6	7.6	6.9	11.8	6.6	8.1
61-80				3.6	6.1	5.3	8.2	10.9	8.3
81-100				----	3.8	2.4	5.9	11.7	7.8
101-125				1.2	3.0	2.4	1.2	11.7	6.8
over -125				4.7	9.8	4.7	27.0	33.6	20.6
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

TABLE 9: Skiing Activity Comparisons After Taking Up Cross-Country Skiing.

mount of Downhill Skiing	% of Respondents Who Downhill & Cross-Country Ski
More	10.3
Same	23.8
Less	65.9

y the cross-country skier are interesting, ome of the other trends seem to provide eeper insight concerning the participants n this activity. The relationships between ownhill skiing, snowmobiling, and cross-ountry skiing are but a few of interactive rends which have been studied.

ownhill and Cross-Country Skiing Relationship Trends

In the Maine study, 74.9 percent of the ross-country skiers had participated in ownhill skiing. Of these, 65.9 percent indi- ated that they had reduced their level of articipation in downhill skiing since taking p cross-country skiing (Table 9). The easons given for downhill skiing less were umerous and varied but high costs, crowding, nd changed opportunity (time and facility roximity) were dominant (Newby and Lilley 980). Among those who downhill ski less fter taking up cross-country skiing, the igh expenses of downhill skiing was indicated s a reason by 57.2 percent of the respondents. dditional reasons for the shifts in activity re given in Table 10.

ABLE 10: Principal Reasons for Decisions to Downhill Ski Less.

Reasons	% of Those Skiing Less
ownhill Expensive; X-C Cheaper	57.2
ross-Country Skiing Less Crowded	27.2
refer Cross-Country Skiing	25.9
ownhill Skiing less Available	18.5
ross-Country Safer & Within Abilities	13.4
ross-Country More Available	11.7
ross-Country Provides More Exercise	7.0
islike Downhill Social Atmosphere	6.0
ross-Country Quieter	6.0
islike Downhill Skiing	5.4
amily & Friends Can Participate Better in X-C	4.3
eason Not Related to Cross-Country	3.7
her	8.6

For shifts in activity wherein those who had taken up cross-country but were downhill skiing more, the two principal reasons given were first, increased availability of downhill skiing opportunties (28.8% of participants) and secondly, an expressed preference for the downhill sport (23.8% of participants). Respondents who now downhill ski more expressed reasons which were less specific but do show similar kinds of criteria (Table 11).

TABLE 11: Principal Reasons for Decisions to Downhill Ski More.

Reasons	% of Those Skiing More (n=80)
Downhill Skiing More Available (Time, Proximity, etc.)	28.8
Prefer Downhill Skiing	23.8
Family Can Downhill Ski Also	3.8
Not Related to Cross- Country	5.0
Downhill More Exercise	2.5
Other	13.8

Research conducted by others has suggested that perceived high costs, crowding, and relative opportunity to participate are common concerns which shape the trends of winter recreation activities (Haas, et.al. 1980; Smith 1980; USDA, Forest Service 1980; Stynes 1980). There are sufficiently large enough numbers of individuals who both downhill and cross-country ski to warrant further analysis of the interactions in order that the concepts such as the opportunity spectrum concepts proposed by Driver and Brown (1978) might become applicable in day-to-day resource management. Trend data analysis and responsive flexible management programming can be achieved to more fully satisfy participant needs.

Participation in winter recreation activities is really more broadly based than many resource managers care to admit. They also tend to dislike accepting the fact that there are many "shared" elements of winter recreation activities but perhaps more importantly they tend to dismiss the oftentimes small incompatibilities which mean the difference between an "experience" and a "quality experience". Cross-country skiers and snowmobile users are often thrown into the same area to "experience" their individual activities, but can this be done? Are the experience differences great or are they relatively miniscule yet extremely critical to need satisfaction? Trend data produce some insights which are important to both user and resource manager, particularly when confronted with such seemingly incompatible activities as cross-country skiing and snowmobiling.

Cross-Country Skiing and Snowmobiling Interaction Trends

Of all the winter recreation activity combinations possible, cross-country skiing and snowmobiling seem to be the most polarized. Perhaps a look at some basic data may verify or refute this concept. In the Maine study of cross-country skiers, 34.8 percent of the respondents had either borrowed, owned, and/or rented a snowmobile during the 1976-1977 winter season (Table 12).

TABLE 12: Percentages of Respondents Sub-sample (n=363) who Borrowed, Owned, or Rented a Snowmobile.

Use Status	% of Respondents
Borrowed	27.4
Owned	16.0
Rented	2.5

Of those who had used a snowmobile (n=363), 72.7 percent indicated they used the snowmobile less often after they began cross-country skiing (Table 13). Interestingly, those who continued to snowmobile, generally tended to assume the role and perceived imagery of the activity in which they were participating. Where perceived conflicts surfaced, the cross-country skier (who may also snowmobile) tended to be more intolerant during participation, i.e., this individual might almost seem to be Dr. Jeckyl and Mr. Hyde, depending on which role or image he was currently adopting.

TABLE 13: Snowmobiling Activity (Percent) of Respondents After Taking Up Cross-Country Skiing.

Activity Levels	All Users	Source of Snowmobile		
		Borrowed	Owned	Rented
More	4.1	5.5	3.1	5.6
The Same	23.2	23.2	25.2	33.3
Less	72.7	71.3	71.7	61.1
	100.0	100.0	100.0	100.0

Some of the primary reasons for snowmobiling less were (a) dislike for snowmobiling, (b) more interest in cross-country skiing, and (c) reduced opportunity to snowmobile (Table 14). Such concerns as noise, smell, and environmental intrusion often were heavy contributors to dislike of snowmobiling and resultant reduced participation.

TABLE 14: Reasons For Snowmobiling Less After Taking Up Cross-Country Skiing (Percent of Respondents Where n=264)

Reason	% of Respondents
Dislike Snowmobiling	36.0
More Interested in Cross-Country	27.3
Less Opportunity to Snowmobile	21.6
Dislike Associated Environmental Impact	9.8
Cross-Country Provides More Exercise	9.5
Cost of Snowmobiling	8.3
Never Developed Taste for Snowmobiling	6.4
Family and Friends Don't Participate	3.4
Other	3.8

For those individuals who snowmobiled more after taking up cross-country skiing, the major reason for doing so was the increased opportunity, however, only 15 persons of the sample population (n=1042) had actually increased their snowmobiling activity. In most instances either availability of a snowmobile or desire to fully capitalize on machine investment were motivations behind greater or increased opportunity for snowmobiling.

The principal interaction between the cross-country skier and the snowmobiler was in the area of tolerance for each other. Snowmobilers expressed no concern with sharing an area with or encountering a skier, whereas the cross-country skier had almost unanimous intolerance for encounters with snowmobilers. When a snowmobiler also skied, he adopted basically the same attitude and expressed a strong dislike for what Newby and Warner (1980) described as the "crude bullies of field and forest". The intricacies of this role adoption are interesting and suggest perhaps that trend evaluation must address what might be termed the "psychological contracts" associated with participation in each recreation activity.

IMPLICATIONS OF TREND ANALYSIS

Researchers who develop trend data and those who interpret that data frequently lose sight of a real value associated with understanding trends, i.e., the potential to satisfy human need through better management. With the complex array of opportunities in winter recreation, it is pathetic and perplexing that the research being done has no common cus -- no deliberate attempt to solve manage- nt problems or address human need. In a cent symposium, no less than fifteen papers re presented on cross-country skiing topics. ose in the audience who came seeking possible nagement solutions went away shaking their ad, wondering why all the existing data re not analyzed and focused to help them. ter all, isn't there a difference between plied research and pure research? Yet, om a research standpoint the symposium was success, mainly because the data were broad d deep in scope, nontheless, the interpre- tions were narrow and shallow. Why? To lp answer the question, let's explore the sue of cross-country skiing and the appli- tion of current trend analysis.

Trend data for comparison between oss-country skiing participants on weekends rsus weekdays shows that cross-country iing is distributed throughout the week. is might eliminate the need to manage for ak periods on weekends -- or does it? We so see that weekday users ski fewer hours r day (2.6 hrs.) than weekend users (4.2 hrs.) t ski more days per season. In addition, ekday skiers ski closer to home but may uble their travel distance for a weekend ip. Obviously this suggests potential rketing analysis -- but does it really tell nagers what they want to know about pro- ding opportunities and meeting needs? antification often provides results which too abstract, too esoteric, too general, too specific to be of use to managers and anners. Indeed, the researcher may prove results to be reliable, but he may also ve them to be invalid and useless within realms of practical assistance to the ager. Many managers are concerned about fts... shifts from or among winter recre- on activities. What are these shifts and t are the frequencies or relative perman- ies of these shifts? Most changes are urring during the active learning years involvement with an activity, ie., during third to sixth years. These are the years t critical to supply/demand decisions, refore, sensitivity to reasons or motiva- ns to change, to adopt, to complement, or drop an activity is of particular importance managers.

Perhaps the image held of a recreation ivity may be the best barometer to measure fts. Think about it; what are the popular ges today? What were they five years ago? sibly, images and imagery may be more im- tant to understand than the motivations a particular behavior pattern. A tragic w in the analysis of trend data is that ticipant responses are often tailored to their image of what an activity is all ut. Their participation is often a re- ction only of the individual's desire to adopt the image of the activity -- that's their motivation. Cross-country skiers may well be skiing more on weekdays than weekends because it is easier to assume the role or image on weekdays. The image (myth induced) of the cross-country skier most often articulated vocally and pictorally is that of a solitary figure etching fine lines in the unbroken snow -- an image that is new, unique, and wholesome -- an image as complex as the people adopting it (Newby and Warner 1980). Weekend use is often social interaction motivated and the antithesis of the imagery of the cross-country skier. The motivations (image adoption) are undoubtedly different and management action to satisfy motivated need must also be different.

The concept of image adoption is not new nor are the principles undefined or unresearched, however, the question might be asked, does image adoption reflect the inner self and result in behavior which is definitive in terms of image consciousness and image strength? Images may be the vehicles for various degrees of self-expression and may be tailored to counter the physical, psychological, social, and economic constraints imposed on the individual. The myths, images, and behavior associated with cross-country skiing are probably more important to understanding this winter activity than are all the long arrays of computer-generated data combined. The numerous statistical profiles available are informative and often impressive but not terribly enlightening.

When only the experience itself is analyzed, a great deal of confusion begins to surface. Are we perhaps leaving out the land resources? After all this is the setting or backdrop for the activity -- this is what the managers must also manage. A sense of identifiable "place" (having a specific image) is also a requirement in the image fulfillment. In short, the researchers should be acutely aware of the "psychological contract" that rests in the minds of the participants...the contract that is written in mental images and is either fulfilled or denied by the actual participation in the activity within a certain setting or place. Each image, each place, each psychological contract helps define how to meet the individual's needs, and these are all part of the trend analysis leading to management problem-solving.

To date, researchers have not programmed the image of a user and his resource into a computer terminal. That is not to say it won't be done before long, but it is important to remember that a land resource has definable attributes which create images in function as well as form. Users probably seek out particulr resources (landscapes) which meet the requirements that they have mentally created to meet their needs, motivations and preferences. If this sounds like a myth, that is exactly the point, because imagability is often associated with mental projections of myths and the desire to identify with those myths as part of the behavioral progression within the basic needs hierarchy.

The paradox of images and myths is that they are real; they are manufactured; they lead to stereotyping; they are associated with self-image; they create identity; and their adoption supports concepts of self. They are the foundation of the imagability of a recreation activity. Yet, we know so very little about them because our data collection and interpretations focus on quantification of users and participation patterns. The interaction of resource imagery with the myths and the images supporting a particular activity has been and perhaps will continue to be the most difficult variable for the researcher to isolate.

Perhaps this is the time to stop making the pretense that all qualities are quantifiable and those qualities which are not quantified are not important. The scientist clad in white coat and clutching his volumes of computer print-outs may have valuable information and he may prove his objectivity, but many managers don't seem too impressed these days. They still have their problems to solve. Perhaps the trend of trend data analysis should be to bring the interpretation of trends within a context of imagery, image adoption, image fulfillment and behavior profiles which effect not only the users but the managers' resources. Certainly this will require some innovative procedures for using quantified data within the more qualitative realms but the rewards may be more richly rewarding than the everpresent cry -- "MORE DATA IS NEEDED!" Much of these types of data are available for winter recreation activities. We just seem to lack the imperative needed to reach out beyond the secure bounds of quantification and cautious extrapolation. Perhaps now is the time to start a trend... a trend that sythesizes the existing quantitative and qualitative data into a net result which is capable of solving problems for resource management and human needs.

LITERATURE CITED

Ballman, Gary. 1980. Operationalizing the cross-country skiing opportunity spectrum. Proceedings of the North American Symposium on Dispersed Winter Recreation, University of Minnesota, St. Paul, MN. pp. 31-35.

Brown, P.J., B.L. Driver, D.H. Bruns, and C. McConnell. 1979. The outdoor recreation opportunity spectrum in wildland recreation planning: Development and application. Proceedings of the First Annual National Conference on Recreation Planning and Development, American Society of Civil Engineers, New York, NY, Vol. 2, pp. 527-538.

Driver, B.L. and S.R. Tocher. 1970. Toward a behavioral interpretation of recreational engagements, with implications for planning. In B.L. Driver (Ed.) Elements of outdoor recreation planning, University of Michigan, Ann Arbor, MI, pp. 9-31.

Driver, B.L. and R.C. Knopf. 1977. Personality, outdoor recreation, and expected consequences. Environment and Behavior 9(2):169-193.

Driver, B.L. and P.J. Brown. 1978. The opportunity spectrum concept and behavioral information in outdoor recreation supply inventories: a rationale. Proceedings of the Integrated Inventories of Renewable Natural Resources Workshop. USDA, Forest Service, Tucson, Arizona. pp. 24-31.

Haas, G.E., B.L. Driver, and P.J. Brown. 1980. A study of ski touring experiences on the White River National Forest. Proceedings of the North American Symposium on Dispersed Winter Recreation, University of Minnesota, St. Paul, MN. pp 25-30.

Hendee, J.C. 1974. A multiple-satisfaction approach to game management. Wildlife Society Bulletin 2(3):104-113.

Keith, J.E. 1980. Snowmobiling and cross-country skiing conflicts in Utah: Some initial research results. Proceedings of the North American Symposium on Dispersed Winter Recreation, University of Minnesota, St. Paul, MN pp. 154-160.

LaPage, W.F. 1971. Cultural "Fogweed" and outdoor recreation research. Proceedings of the Forest Recreation Symposium, State University of New York College of Forestry, Syracuse, NY, pp. 186-193.

Newby, F.L. and W.D. Lilley. 1978. Cross-country skiers in Maine: A preliminary study. Life Sciences and Agriculture Experiment Station Misc. Report No. 197, University of Maine, Orono, ME.

Newby, F.L. and W.D. Lilley. 1980. Cross-country skiers: Are they really different? Proceedings of the North American Symposium on Dispersed Winter Recreation, University of Minnesota, St. Paul, MN, pp. 52-56.

Newby, F.L. and W.S. Warner. 1980. Cross-country skiing: Images, myths, and behavior. Unpublished booklet used in the poster session of the North American Symposium on Dispersed Winter Recreation, University of Minnesota, St. Paul, MN.

ith, C.K. 1980. Ski touring in the Twin Cities area. Proceedings of the North American Symposium on Dispersed Winter Recreation, University of Minnesota, St. Paul, MN, pp. 42-46.

ynes, D.J. 1980. Interrelationships among three outdoor winter sports. Proceedings of the North American Symposium on Dispersed Winter Recreation, University of Minnesota, St. Paul, MN. pp. 132-138.

DA, Forest Service. 1980. Growth potential of the skier market in the National Forests. USDA For. Serv. Res. Pap. WO-36, 31 p.

A POSSIBLE RAILROAD ORIENTED SCENARIO IN POTOMAC RIVER BASIN PLANNING[1]

George H. Siehl[2]

A trend may develop in which railroads become lifelines between rural and urban populations. For instance, the railroad along the Potomac River presently serves commuters from Washington's western suburbs. The railroad could be used to reclaim surface mined areas in the upper portion of the Potomac. These same lines can also open western Maryland as a recreation resource to Washington, D.C., residents. Multiple use of railroads is a trend recreationists would find beneficial.

My remarks are directed to one possible future for recreation in the Potomac River Basin, a future which would see the expanded use of the existing railroad system through the basin. The scenario is an extension of a report done for the Senate Committee on Governmental Affairs in 1979. A version of the report has been reproduced by the Congressional Research Service with permission of the Committee under the title Outdoor Recreation Consideration in River Basin Planning and Management. Copies are available upon request.

The purposes of the report were listed as:

1. To identify and review some of the new river relevant resource management and environmental programs that have been authorized since the early 1960's;
2. To show some of the changed public perceptions of river and other natural resource management approaches;
3. To discuss pertinent shifts in public sentiment toward the issues of economic growth and the role of government;
4. To anticipate the possible changes which may follow from the above considerations with regard to outdoor recreation and landscape preservation; and
5. To apply these considerations to a single river basin, the Potomac, and speculate on how these considerations, and perceptions might be incorporated in planning for the future of that basin.

It is to the last of these purposes that this paper is addressed.

TOMORROW'S POTOMAC

Tomorrow's Potomac--and Tomorrow's America--are not likely to be based upon recreation; neither is it likely, one hopes, that issues such as war and peace, energy supplies, or interpersonal relations will worsen to the point where life is reduced to a stark, continual struggle for survival. Recreation is not the most important matter before our elected leaders, but it *is* important enough to deserve consideration when issues of greater import are being decided. Within this framework, what are the prospects for recreation in the Potomac River Basin?

First, the Potomac Basin Planners could make use of any of the new approaches to resource management which have been developed elsewhere by the federal, state, or local governments or by the private sector. To the extent that these off-the-shelf approaches are not compatible with the specific circumstances of the Potomac River Basin, they can be adapted to specific needs and situations in the Potomac region.

Additionally, the abundant intellectual resources of the Potomac Basin could supply new approaches to managing the man-land interaction. These new approaches might best be directed to forging programs which deal with environmental problems while providing recreational benefits, and to developing an energy/transportation system which allows for continuation of a broad range of recreational outlets. While these two concepts do not exhaust the possible new approaches to affording recreational opportunities in the Potomac River Basin, their implementation could do much to ensure that outdoor recreation options could be increased as needed.

---

[1] Paper presented at the National Outdoor Recreation Trends Symposium, Durham, NH, April 20-23, 1980.

[2] Analyst in Environmental Policy, Congressional Research Service, Library of Congress, Washington, D.C. 20540.

Mined Land Reclamation

As an example of the kind of environmental problem which might be solved so as to provide recreational benefits as a byproduct, there is the matter of surface mining of coal in the upper portion of the Potomac Basin.

The mountainous reaches of the upper basin are generally under forest cover or in some kind of agricultural use. In this condition they provide economic returns through the harvesting of timber or agricultural products; wildlife habitat is undisturbed; a variety of recreational activities is possible; and any off-site environmental damage is minimal.

When surface mining takes place, the timber must be harvested on a one-time basis before mining begins, and the coal is recovered. These would be the economic benefits of mining. Negative factors involved in surface mining include elimination of the recreation potential; loss of wildlife habitat; and, in many cases, the beginning of serious off-site environmental damage such as siltation.

In the post mining phase, if there is no reclamation, the situation results in no economic costs to restore the contour and vegetation of the site, but places the land in condition to be used for other purposes and eliminates off-site environmental damage.

Imaginative programs for reclaiming surface mined mountainous areas could include use of the mined area by the coal cars which now return there empty.

Similarly, sludge from water treatment plants could be brought in to facilitate the process of revegetating the landscape or upgrading the soil for agricultural use.

While these actions would help to solve several environmental problems, recreation could benefit through use of the area for appropriate outdoor activities. Off-road vehicles could use a part of the area and the reclamation plan could lead to development of an area suitably contoured for downhill skiing. Restoration of vegetative cover which could provide food and shelter for wildlife could increase hunting opportunities. Creation of lakes or ponds on the previously mined lands could provide water-based recreational opportunities. In some cases, where chemistry of the water would permit, fishing might be possible as one of the recreational uses.

Experience elsewhere has shown each of these elements to be possible.[3] An all-out effort by private and public sectors working together might be able to try all of these programs and make them work in the region. There are, however, technical and temperamental obstacles to making such a comprehensive effort succeed.

Rails as Trails

A transportation program which could have multiple benefits accruing to the public and private sectors of the basin economy would be the development of recreation oriented railroad service to western Maryland.

The rail lines are in place and Amtrak passenger trains now travel the route passing through a number of small communities which are close to outdoor recreation centers. These include Maryland's Deep Creek Lake (which is in the Ohio Basin drainage, but this can be overlooked for purpose of discussion), Blackwater Falls and Canaan Valley State Parks in West Virginia, and a number of points on the Potomac River much used by hikers, campers, fishermen, and boaters. The Amtrak passenger trains make only a limited number of station stops along this route, and the schedule does not closely match what would be ideal for recreational users. This Amtrak route (Washington, D.C., to Cincinnati, Ohio) is one that the Department of Transportation had proposed to eliminate, but the route is to operate for about a year pending further evaluation.

Components of the program would include:

1. Use of existing or added railroad passenger trains to provide access to upper basin communities for outdoor recreationists;
2. Development of these communities to provide needed services and/or accomodations to the visitors;
3. Development of transportation systems to move visitors from the communities to specialized recreation areas;

---

[3] For instance, see the section on reclamation in U.S. Congress. Senate. Committee on Interior and Insular Affairs. The Issues Related to Surface Mining: A Summary Review, with Selected Readings. (Committee Print) Washington, U.S. Govt. Print. Off., 1971. 255 p.

4. Expansion or creation of specialized outdoor recreation areas, as needed.

In the case of downhill skiing, for nstance, the program might work, as follows, uring an assessment period. Skiers would eave the Washington area on a rescheduled mtrak train at about 6:00 p.m. on Friday eveing, reaching Oakland, Maryland, at about 1:00 p.m. They would be transported to their odgings in vehicles provided by the lodge or otel at which they were to stay. (This transort could be something as simple as a conractor-owned school bus or, if the program ustified it, a more elaborate motor coach.) estinations could be the Wisp ski area near eep Creek Lake in Maryland, or the previously entioned Canaan Valley, West Virginia. Snowhoe ski area in West Virginia would be another ossibility, although its distance from Oakand would make for a rather late arrival on he schedule being considered. Following a eekend of skiing, the process would be eversed, and the recreationists would be eturned to the Washington area Sunday evening.

Should the program prove successful, it ould possibly lead to development of a new ownhill ski area in the vicinity of Cumberand, Maryland, if the mountainous terrain and now cover there prove suitable. Much of this and is in private ownership, providing an pportunity for further involving the private ector in increasing recreational opportunities.

The benefits to be derived from this proram would include expanded and more accessible ecreational opportunities (many young people iving in the urban area are interested in such ctivities, but do not own an automobile). lso, there would be expanded employment opporunities in essentially rural areas.

The rail recreational access program would unction equally well in summer. In Norway, or instance, it is a common sight on the trains hich cross the mountains between Oslo and ergen to see a group of hikers step from the rain, their packs upon their backs, and set ff on foot for hostels or campgrounds. There ould appear to be no reason why a similar sitution would not prevail in the Potomac Basin. n fact, the recent popularity of biking might e accommodated through this system, as well.

Apart from Amtrak, another source of raiload rolling stock which might become available ithin the Potomac Basin in the next several ears is the equipment used for commuter traffic nto Washington, D.C., on weekdays. The state f Maryland, which provides financial support or this rail commuter service through its epartment of Transportation, has recently rranged to purchase additional equipment to xpand the system. Some 22 cars to be acquired ill be refurbished and placed in operation, probably not before the end of 1980 or early 1981. Once operational, however, the state might be interested in allowing them to be used, perhaps on a lease basis, for the recreational access program on weekends. In this way, a portion of the costs of acquiring the cars might be offset, and the recreational access program would be more flexible. It would be necessary to limit use of the cars in such a way that maintenance, which is done on weekends, could be performed in a timely fashion.[4] Other recreational train potentials: hiking, bicycling, resort living, fishing, trips, boating, C & O Canal towns, historical towns.

Whether or not these ideas come to play a part in shaping Tomorrow's Potomac, the larger concern is how that future is to be shaped. That it will be different seems certain; the means of making it so are uncertain.

---

[4] Telephone conversation Sept. 5, 1979, with J. H. Griffin, Manager of Passenger Operations, Baltimore and Ohio Railroad Company.

CHANGES IN RECREATION ORIENTED TRAVEL IN THE NORTHEAST BETWEEN 1972 and 1977[1]

Gerald L. Cole[2]

Abstract.--Data from the National Travel Surveys of 1972 and 1977 are utilized in a modified shift-share approach to compare Northeastern travel with other regions of the U.S. The Northeast is losing relative to other regions when travel is compared using 1972 as the base year. However, travel with camping equipment increased in the Northeast relative to the other regions.

INTRODUCTION

One of the sub-objectives of the NE-100 regional research project at Northeast Agricultural Experiment Stations has been to utilize secondary data sources as a means of detecting changes in trends in outdoor recreation participation. This paper focuses on the National Travel Surveys conducted in 1972 and 1977 by the U. S. Department of Commerce.

Data tapes for both surveys were released to research personnel at the University of Vermont, enabling a comparison between the two survey years. For the households sampled, all travel for trips of 100 miles or more from home was recorded by purpose of the trip, mode of travel and origin and destination of the trip. Also, person trips (number of trips x number of persons) and person nights (person trips x number of nights away from home) were included.

This paper was developed because of some hypothesized changes occurring in the Northeast region which could affect the recreation-tourism sector. It may be useful to outline some factors associated with travel and then elaborate on some hypotheses concerning the region. Variables which affect the demand for travel include population, income, education and family size. On the supply side, the natural resource base for tourist attractions, highway availability and condition, together with technological advances, will also be important.

It is hypothesized that the demand for travel in the Northeast will slow because of slower population growth compared to other regions of the U.S. Pennsylvania, New York, Rhode Island and the District of Columbia are estimated to have population decreases between 1970 and 1977. While incomes have continued to increase in the region, price increases for some consumer goods have outstripped income growth. This is especially true for gasoline prices which have risen sufficiently to cause a reduction in fuel used between 1979 and 1980. It is hypothesized that higher fuel prices will reduce the demand for travel not only for persons originating their trip in the Northeast region, but especially for those from outside the region.

Continued increases in the level of education and the trend towards smaller households (including one person households) should spur an increased demand for travel which may partially offset the negative effects of reduced population growth and higher fuel prices.

On the supply side, it is hypothesized that those natural resource attractions which are within 100-150 miles of important population centers will have an advantage over more remote areas. To illustrate, the Delaware, Maryland and New Jersey shores together with Cape Cod, will be in a better relative position than attractions in Northern New England.

New technological developments which promote more fuel efficient recreation vehicles, outboard engines, etc. can also stimulate participation in camping and boating.

---

[1] Paper presented at the National Outdoor Recreation Trends Symposium, Durham, NH, April 20-23, 1980.

[2] Associate Professor, Dept. of Agricultural and Food Economics, University of DE, Newark. The valuable assistance from Malcolm I. Bevins and Jed Guertin, University of VT, is greatly appreciated. Bevins presented a preliminary analysis of some of the possible uses of the National Travel Survey Data at a NE-100 research meeting. Guertin provided computer programming assistance.

OBJECTIVE

The objective of this paper is to utilize the travel data from the two survey years in order to indicate shifts in the shares of travel and other related factors by state, region - Mid-Atlantic, New York-New Jersey, and New England - and the Northeast between 1972 and 1977, compared to other regions and the U.S. Shifts in travel market shares will be compared with population growth shares for the same states, regions and the U.S.

PROCEDURE

A modification of shift-share analysis will be used to measure changes in the state and regional travel share compared to the U.S.

Shift-share analysis is a technique for measuring factors which relate to differences in growth rates among regions. The technique was developed by Dunn who states:

> "Regional development takes place in a national framework and depends in part upon forces operating at the national level. As output and income grow, the demand for different commodities grows at different rates. Likewise, on the supply side, technological change leads to differential shifts. The impact of changes at the national level affects regions in different ways because of differences in the composition of their output." 3

In this paper, the number of person nights of travel in 1972 and 1977 by state of destination will be used as the variable to measure shifts. It is argued that person nights provide the best available measure of economic impact because both the number of persons in the travel party and the number of nights spent on the trip are recorded.

An analysis of other state and regional travel data utilizing SPSS provides additional indicators of growth or decline in the travel market within the region.

RESULTS

Population growth and shift-share

It is well known that population growth in the Northeast has not kept pace with other regions since 1970. While U.S. population increased 6.4 percent between 1970 and 1977, the Northeast region's population increased only by 1.4 percent, Table 1. The Northeast region in this study includes 13 states and the District of Columbia.[4] Population grew fastest in the South and in the Northwest.

A shift-share analysis of population compares not only the percentage increase, but also the 1970 base population in each of the states and regions. In order to calculate what will be called the Population Share Index Value, the following formula is used:

$$\text{Population Share Index Value} = \left[\begin{array}{l}\text{Base population}\\ \text{for state or}\\ \text{region (1970)}\end{array}\right]$$

$$\left[\begin{array}{l}\text{Percentage change in}\\ \text{state or regional pop-}\\ \text{ulation from 1970-77}\end{array} - \begin{array}{l}\text{Percentage change}\\ \text{in U.S. popula-}\\ \text{tion from 1970-77}\end{array}\right]$$

Table 1. Population growth for the United States, by region, and for Northeastern states between 1970 and 1977.[a/]

Region	1970	1977	Percent change
	- - (000) - -		
U.S.	203,806	216,332	6.4
New England	11,883	12,242	3.3
ME	997	1,085	9.2
NH	742	849	15.0
VT	446	485	8.7
MA	5,706	5,782	1.6
RI	951	935	-1.6
CT	3,041	3,108	2.5
NY-NJ	25,461	25,253	-0.8
NY	18,268	17,924	-1.7
NJ	7,193	7,329	2.2
Mid-Atlantic	23,468	24,190	3.1
DE	551	582	6.1
DC	756	690	-8.8
MD	3,938	4,139	5.5
PA	11,813	11,785	-0.1
VA	4,659	5,135	10.4
WV	1,751	1,859	6.6
Northeast	60,812	61,685	1.4
South	37,573	41,803	11.2
North Central	46,960	47,911	2.0
Northwest	7,097	7,957	12.1
Southwest	23,555	26,254	11.4
Pacific	27,811	30,722	10.5

a/ Source: U. S. Department of Commerce, Statistical Abstract of the United States - 1978, pp. 14-15.

---

[3] Dunn, Edgar S., Jr., "A Statistical and Analytical Technique for Regional Analysis," The Regional Science Assoc., Papers and Proceedings, Vol. VI (1960).

[4] Some of the names of travel regions were changed in 1977 compared to the 1972 National Travel Survey. In this paper, the 1972 names will be used. See Appendix A for the definitions of travel regions.

The result of these calculations is own in Figure 1. The position of each state region on the bar chart is based on (1) e size of the 1970 population, and (2) ether the state or regional percentage pulation change between 1970 and 1977 was eater or less than the U.S. change. Thus, the state or region had a population change ich exactly coincided with the U.S. change, e index value would equal zero, i.e. would on the base line. If the regional change s greater than the U.S. change, the index lue would be positive and conversely, if e regional change was less than the U.S. ange, the value would be negative.

The Northeast region shows the greatest gative index value and the Southern region e greatest positive value. Regions also owing a negative share index include rth Central, New York-New Jersey, Mid-lantic and New England. The Northeast lue is a composite of the New York-New rsey, Mid-Atlantic and New England regions.

On the positive side of the base line, addition to the Southern region, are the rthwest, Pacific and Southwest regions. ile the Northwest region had the largest rcentage population growth between 1970 d 1977, the smallest base population of y of the regions resulted in a smaller sitive index value.

Among the individual states in the rtheast, only five grew at a faster rate than the U.S. and exhibited positive values. Only Virginia among the five had a population over one million. Therefore, the values do not deviate significantly from the base line.

On the negative side, Pennsylvania and New York, the two most populated states in the Northeast, both lost population between 1970 and 1977. The combined effect of population loss in New York, Pennsylvania, Rhode Island and the District of Columbia, together with population growth at less than the national rate in seven other Northeastern states, generated the negative Northeast index value.

The bar chart provides a measure of relative growth and decline in state and regional population shares between 1970 and 1977. Population growth or decline is one of the most important variables affecting travel in the regions.

Person nights of travel and shift-share

Using the same procedure as for the population analysis, state and regional growth in person nights of travel is indicated in Table 2. Data for the smaller states were not published in 1972. Therefore, a state comparison for Connecticut, Rhode Island, New Hampshire, Vermont and Maine is not possible. However, data for the New England Region are available. While the number of person nights of travel increased 26 percent nationally between

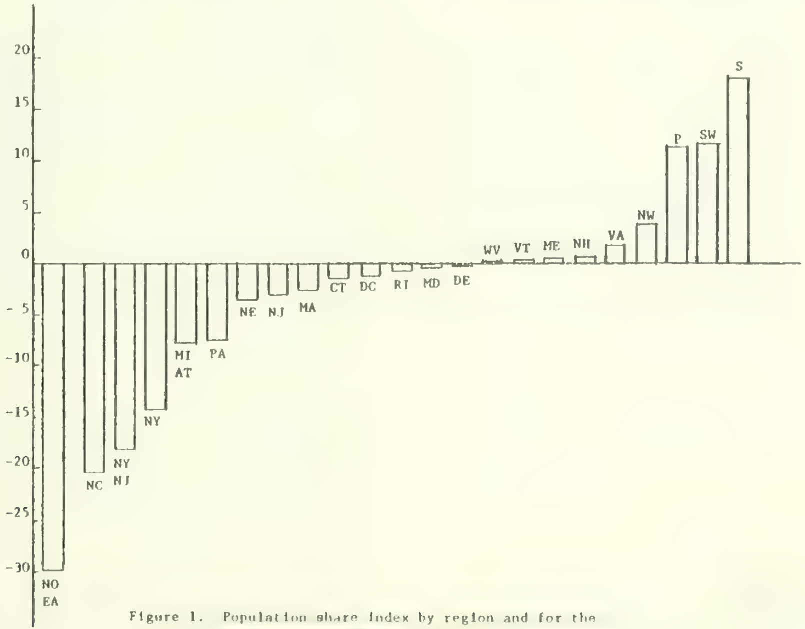


Figure 1. Population share index by region and for the Northeastern states, 1970-1977.

1972 and 1977, the increase in the Northeast was only 15.9 percent and the New England states registered a smaller 5.5 percent increase. Within the Northeast, person nights of travel actually decreased by 8.3 percent in Pennsylvania.

Table 2. Person nights of travel for the United States, by region, 1972-1977.a/

Region	1972	1977	Percent change
	- (000,000) -		
United States	1,906.0	2,367.3	26.0
New England	97.0	102.3	5.5
NY-NJ	101.1	120.3	19.0
Mid-Atlantic	137.6	166.4	20.9
Northeast	335.7	389.0	15.9
South	385.2	501.5	30.2
North Central	278.7	354.0	27.0
Northwest	91.6	118.3	29.1
Southwest	207.0	290.1	40.1
Pacific	272.1	325.4	19.6

a/ Source: U. S. Department of Commerce, Bureau of the Census, 1972 and 1977 National Travel Surveys.

In other regions, the Southwest exhibited a 40.1 percent increase followed by the South and the Northwest.

Within the Mid-Atlantic states, increased travel to the District of Columbia and Virginia exceeded the national increase.

A shift-share analysis of person nights of travel by destination state or region is presented in Figure 2. The formula for computing what will be called the Travel Share Index Value is as follows:

$$\text{Travel Share Index Value} = \left[\begin{array}{l}\text{Base person nights}\\ \text{of travel for state}\\ \text{or region (1972)}\end{array}\right] \left[\begin{array}{l}\text{Percentage change}\\ \text{in state or re-}\\ \text{gional person}\\ \text{nights of travel}\\ \text{from 1972-77}\end{array} - \begin{array}{l}\text{Percentage change}\\ \text{in national person}\\ \text{nights of travel}\\ \text{from 1972-77}\end{array}\right]$$

Again combining the magnitude of the base year travel with the percentage deviation from the National increase, the largest negative value is obtained for the Northeast region and the greatest positive value for the Southwest. If travel had changed from the base year by region in the same relative proportion as population growth, the ranking of states and regions would be the same as in Figure 1. However, this is not the case. For the travel index, the Southwest gained relative to the South when compared to population index. The value for the Pacific region is negative, while the population value was positive.

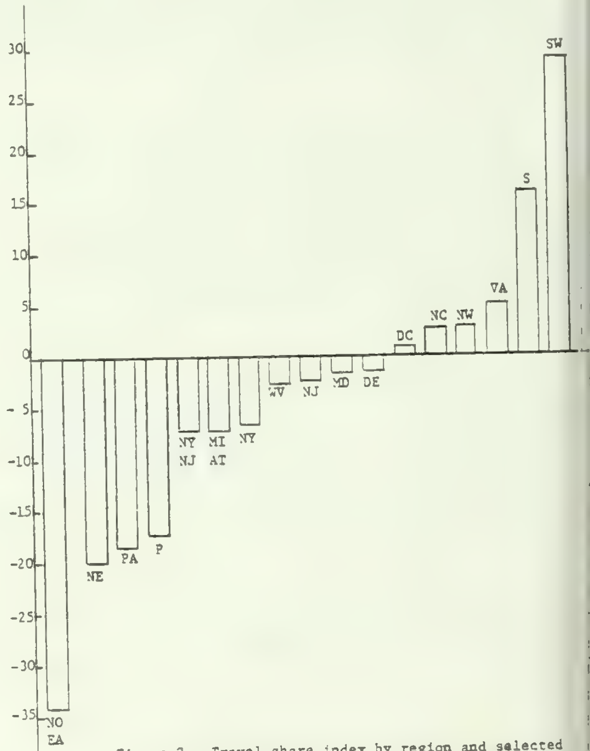


Figure 2. Travel share index by region and selected Northeastern states, 1972-77, based on person nights of travel by destination.

Within the region, only the District of Columbia and Virginia exhibit positive travel index values. Clearly the New England states, New York-New Jersey and the Mid-Atlantic states are losing relative to national growth. The North Central region is the only other region to show a negative value.

Not all states or regions have matched population growth with growth in travel. A causal relationship cannot be established from a shift-share analysis. Only a descriptive analysis of the changes is possible. The description can serve as an indicator of a need for further investigation of the reasons for variation in travel. It is clear that the Northeast is losing relative to other regions except for the Pacific region. Because the regional and state patterns of travel growth are not the same as th atterns of population growth, it is evident hat more than the population variable is ffecting travel. This suggests the need or additional investigation of supply variables and other demand variables in the states r regions most affected, i.e., those which eviate from the base time. For example, re the historical-governmental attractions n the D. C.-Virginia area serving as a major ttractant? Are the attractions in Pennylvania such as Gettysburg, the Amish Country r the Poconos, losing favor? Are the natural esource attractions in Northern New England oo far from population centers?

amping travel shift-share

One indicator of the intent of travelers s whether or not they travel with camping quipment. In the National Travel Survey, rips by personal vehicle with and without amping equipment are recorded. Nationally, erson nights of travel with camping equipent is a relatively small part of total ravel. The proportion of travel with camping quipment varies from three percent in the ew York-New Jersey region to 17 percent in he Northwest.

The increase in person nights of travel ith camping equipment across the U.S. was uite modest - 3.6 percent - between 1972 nd 1977, Table 3. Regionally, a much ifferent pattern emerges than was the ase with all travel. The New England and id-Atlantic regions showed substantial perentage increases in camper travel with maller increases in the South and Southwest. ajor declines were noted in the Pacific and ew York-New Jersey regions with smaller ecreases in the North Central and Northwest egions.

Table 3. Person nights of travel with personal auto/truck and camping equipment, by region, 1972-1977.a/

Region	Person nights of travel		
	1972	1977	Percent change
	- - (000) - -		
United States	160,244	165,990	3.6
New England	7,075	9,678	36.8
NY-NJ	4,564	3,756	-17.7
Mid-Atlantic	8,751	12,596	43.9
Northeast	20,390	26,030	27.7
South	31,971	37,674	17.8
North Central	22,354	21,170	-5.3
Northwest	20,819	19,714	-5.3
Southwest	23,570	28,581	21.3
Pacific	41,140	32,821	-20.2

a/ Source: U. S. Department of Commerce, Bureau of the Census, 1972 and 1977 National Travel Survey.

Using the same procedure as with population and total travel, a Camper Travel Index Value is computed as follows:

$$\text{Camper Travel Index Value} = \left[\begin{array}{l}\text{Person nights of}\\ \text{travel with camping}\\ \text{equipment in base}\\ \text{year (1972)}\end{array}\right] \left[\begin{array}{l}\text{Percentage change}\\ \text{in state or region.}\\ \text{person nights with}\\ \text{camp. equip. from}\\ \text{1972-77}\end{array} - \begin{array}{l}\text{Percentage change}\\ \text{in national person}\\ \text{nights of travel}\\ \text{with camp. equip.}\\ \text{from 1972-77}\end{array}\right]$$

In this instance, the greatest negative value is generated for the Pacific region and the greatest positive value for the Northeast, Figure 3. The Pacific region had the largest amount of travel in the base year and the greatest percentage declines. The positive effect of the large percentage increases in New England and the Mid-Atlantic region relative to the U.S. were the major factors in generating a large positive index value. Thus, even though the Northeast has lost population relative to the U.S. and total person nights of travel have decreased compared to the National rate of change, camper travel has increased.

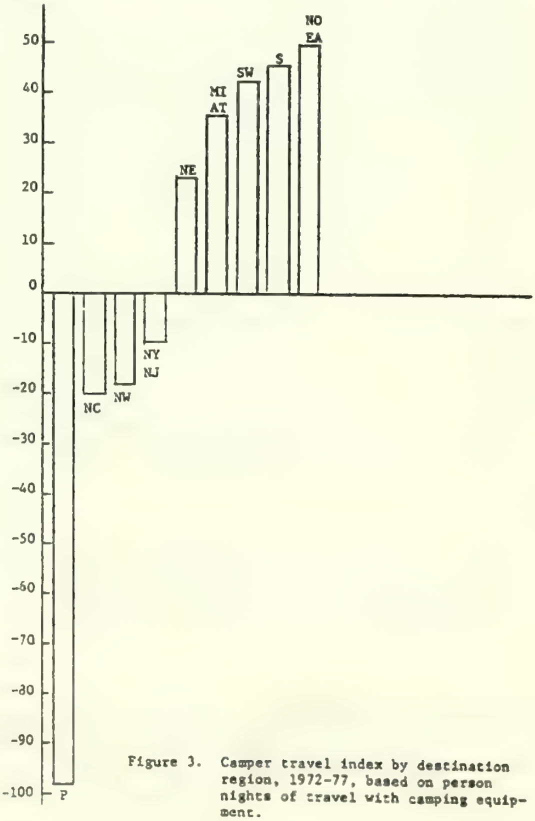


Figure 3. Camper travel index by destination region, 1972-77, based on person nights of travel with camping equipment.

Unfortunately, the lack of the data for the New England states in 1972 (except for Massachusetts) makes a comparison of individual states within the region and nation impossible. Data will be available in future census years, however.

Other comparisons from travel survey data

Numerous comparisons are possible using the National Travel Survey from 1972 and 1977. Selected comparisons follow as examples of possible analyses.

Origin - destination analysis of travelers

For marketing of recreation-tourism services it is essential to know the origin of travelers in order to better pinpoint advertising efforts and to be able to forecast possible impacts due to projected changes in population growth, fuel costs, etc.

An analysis of the origin of travelers to the Northeast (New England-New York-New Jersey and Mid-Atlantic regions) will serve as an example of the type of information that can be generated. Data for Connecticut are illustrated in Table 4.

Table 4. Origin of trips to Connecticut, by region, and selected states, 1972 and 1977.

Origin (Region or state)	Percent of trips 1972	1977
New England	37.4	42.2
NY-NJ	33.4	31.6
Mid-Atlantic	14.8	9.8
Sub-total	85.6	83.6
South	4.8	6.8
North Central	5.2	6.5
Northwest	.2	.2
Southwest	1.6	.7
Pacific	2.4	2.0
Total	100.0	100.0
Major States -		
MA	23.2	31.3
NY	22.8	13.3
NJ	10.6	18.3
RI	6.4	5.0
PA	5.6	5.8
MD	4.0	1.0
	71.6	74.7

In Northern New England, over 90 percent of all trips to Vermont, New Hampshirre and Maine originate in the Northeast and the share from within the region increased for Vermont and New Hampshire between 1972 and 1977. As indicated earlier, the population growth in the Northeast is slower than elsewhere in the U.S. and/or is generated in states with a small population base. If higher fuel costs further deter travel from more distant regions, this has an important potential negative impact on Northern New England. Some impact is already being felt since the total number of trips to Vermont and Maine decreased between 1972 and 1977.

Southern New England (Connecticut, Massachusetts and Rhode Island) is only slightly less dependent on the Northeast for its' travelers. The share for all three states is between 80 and 90 percent. However, Massachusetts, the most populated state, suffered a 22 percent decline in the number of trips between 1972 and 1977. The fact that Southern New England draws a slightly greater share of travelers from outside the Northeast can provide a negative impact as fuel costs escalate.

In the New York-New Jersey region, New York's dependence on the Northeast region increased between 1972 and 1977 primarily due to a decline in travelers from the North Central region. Both New York and New Jersey had 80 percent of their travelers originating in the region in 1977.

New Jersey's proportion of visitors from the Southern region nearly doubled but the proportion from the North Central region was cut in half. This could be due to travel distances. One might further speculate about future impacts in New Jersey with the present and expanding availability of casino gambling in Atlantic City. This can attract travelers from greater distances, particularly by public transportation.

Among the Mid-Atlantic states in the southern part of the Northeast, only Delaware depends on the Northeast for over 90 percent of the travelers coming into the state. An increasing proportion of the travelers came from the Southern region to the Mid-Atlantic states between 1972 and 1977. This was especially true for Virginia and West Virginia. A declining share of travelers came from the North Central region. West Virginia was most dependent on the North Central states.

The Southern states in the Mid-Atlanti region, being closer to the Southern region, may expect a positive impact from increasing population provided that rising fuel costs don't completely offset the effect of population.

While the entire Northeast region will ikely be adversely affected by low or zero opulation growth among some of the states n the region, there will likely be states n the southern part of the region that may xpect to enjoy future growth in the travel arket largely generated from the South. ontinued monitoring of the county employ- ent and expenditure data from other sources ill better establish a causal relationship.

urpose of trip

In the Northeast region, with the xception of Southern New England, there as a slight upward trend in the proportion f trips made for outdoor recreation, enter- ainment and sightseeing purposes, i.e. on-business and non-family related travel. ecreation, entertainment and sightseeing avel as a group accounted for 20-30 per- ent of total travel for the region with a ain of approximately two percentage points etween 1972 and 1977.

de of transportation

There was a slight down trend in the e of private vehicles for travel. Even ough New England is more dependent than e remainder of the Northeast on private ansportation, the private share decreased om 85 to 82 percent between 1972 and 1977. sewhere in the region the private share clined from 76 to 71 percent. Thus, blic transportation is making a slight in. It will be interesting to continue monitor the trend as fuel prices escalate.

mber of persons per trip

There was a tendency for the proportion one person trips to increase between 1972 d 1977. This probably reflects the National end in formation of one-person households. wever, if the trend continues it has plications for the lodging and restaurant dustries, among others. In 1977, slightly er 50 percent of the trips in the region re taken by individuals.

pe of lodging

There was an increase in the proportion commercial lodging (hotels, motels and mpgrounds) used as well as stays with iends and relatives. Therefore, the use the travelers own lodging (second homes, c.) declined.

Distance traveled

Between 1972 and 1977, there was an increased proportion of travel for round trips of 400 miles or less and conversely the share of longer trips diminished. By 1977, slightly over 50 percent of the trips taken were for the shorter distances and slightly less than half for distances over 400 miles.

Limitations

Analyses of National Travel Survey data are subject to certain limitations. The Travel Survey only includes trips which are 100 miles or more each way. Therefore, a major portion of trips by travelers in New England or individual small states, such as Delaware, may go unreported. This would be especially true for travel to resource based attractions - mountains, lakes or seashores - which are relatively close to the traveler's home. The Travel Survey reports fewer trips per capita taken by New England residents compared to those residing in other regions, Table 5. Part of the discrepancy may be due to the exclusion of shorter trips.

Table 5. Trips per capita and per traveling person, by region, and for the U.S., 1977.[a/]

Region	Trips per Capita	Trips per traveling person
New England	1.9	3.4
NY-NJ	1.7	3.4
Mid-Atlantic	2.2	3.8
South	2.4	3.8
North Central	2.7	4.0
Northwest	3.8	4.8
Southwest	3.1	4.4
Pacific	2.8	4.1
United States	2.5	4.0

a/ Source: U. S. Department of Commerce, Bureau of the Census, 1977 National Travel Survey.

If there is a trend towards taking shorter trips, the under-reporting problem may increase. A lowering of the minimum trip length may be warranted in future travel surveys.

The impact of Canadian travel to the U.S., particularly Northern New England, also cannot be measured. Thus, if the number of Canadian travelers is increasing over time this may partially offset the negative effect of fewer American travelers.

SUMMARY AND CONCLUSIONS

The major purpose of this paper was to demonstrate the use of National Travel Survey data for 1972 and 1977 in a modified shift-share analysis of travel in the Northeastern states together with population growth between 1970 and 1977. Additional comparisons of travel data also were made to detect possible trends or changes in travel patterns.

The Northeast had the greatest negative population share index compared to other regions and the U.S. Four Northeast states lost population between 1970 and 1977.

Low or negative population growth influenced person nights of travel in the region between 1972 and 1977. Consequently, the Northeast also had the greatest negative travel share index value. Other regions of the U.S. lost out as a travel destination relative to the National pattern, also. For example, the Pacific region had a negative index value as well. A camper travel index using person nights of travel with camping equipment was generated. In this instance the Northeast had the largest positive index value, because camper travel increased relative to the U.S. and other regions.

The Northeast tends to be highly dependent on persons residing within the region as the source of travelers. Continued slow or non-existent population growth in the region will have the effect of limiting the growth in demand for travel, especially when the impact of rising fuel costs is considered.

Other trends noted include a slight increase in: (1) the proportion of trips taken for entertainment purposes, (2) the use of public transportation, (3) the use of commercial lodging, and (4) the tendency to take shorter trips of less than 200 miles one way.

The analysis has developed some possibl indicators of change in travel in the Northeastern U.S. It will be necessary to examine other secondary sources at the county level o to collect primary data to provide the causes of the changes noted.

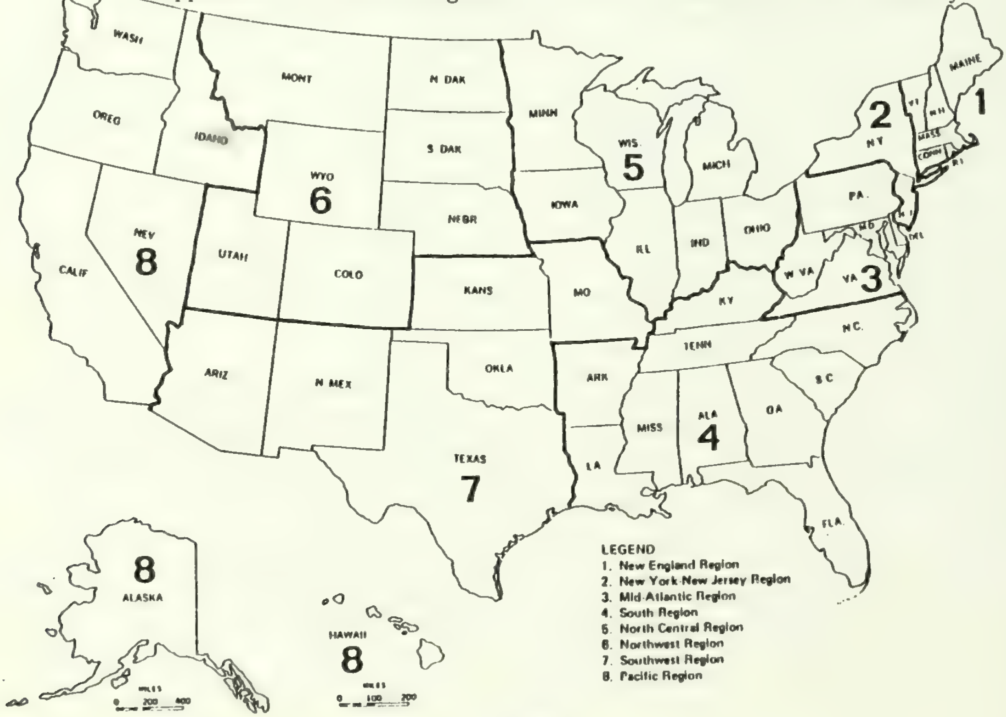
LITERATURE CITED

Dunn, Edgar S., Jr. 1960. A statistical and analytical technique for regional analysis. Papers and proceedings, Vol. 6, The Regional Science Assoc.

U. S. Department of Commerce. Bureau of the Census. 1972 and 1977. National trav survey, Census of Transportation.

U. S. Department of Commerce. 1978. Statist cal abstract of the United States.

Appendix A. Travel Regions of the 1972 National Travel Survey



TRENDS IN ALLAGASH WILDERNESS WATERWAY USES IN THE 1970's[1]

Thomas J. Cieslinski, Supervisor
Planning and Research
Bureau of Parks and Recreation
Augusta, Maine

The Allagash Wilderness Waterway is a -mile long river and lake corridor through e forests of northern Maine. It begins at los Dam at the eastern end of Telos Lake, tends westward to Allagash Stream and lagash Lake in T8 R14, and northward through amberlain Lake, Eagle Lake, and Churchill ke to the beginning of the river itself at urchill Dam. The northern half of the terway, which is essentially river, includes fine stretch of whitewater at Chase Rapids d forty foot Allagash Falls.

Passage of the Allagash Waterway Act in 56 established the framework for protection the river corridor by the State Bureau of rks and Recreation. Companion legislation d to the approval by the people of Maine referendum, of monies for the acquisition a land corridor in average 500 feet wide om the high water mark; the State-owned area ntains 22,760 acres of shore land and proximately 30,000 acres of submerged land. e Waterway legislation also gave to the ate the power to approve timber harvesting erations on all private land within one-mile om the river's edge.

Road access to the Waterway is largely er private lumber company roads; primary cess routes are from Millinocket, Green- lle, Ashland, and Allagash Village. The sitor can also gain access by water; most mmonly into Eagle Lake via Indian Stream om Indian Pond, Allagash Lake by Johnson nd and Stream, and Mud Pond by portage ail from the West Branch Penobscot water- ed. Access by float plane is allowed at signated sites.

The Allagash has a rich and diverse his- ry from the use of the land by native ians, to logging operations, to the visits Henry David Thoreau in the mid-1800's, to use of the river for sport fishing, thru the early protection efforts of the United States government and the State of Maine. In July, 1970, the Allagash was designated as the first State administered component of the National Wild and Scenic Rivers Act of 1968.

The Allagash is now staffed by a supervisor with assistance from several year-round and seasonal rangers, who are responsible for maintaining approximately 72 campsites for summer use. The area also receives increasing snowmobiling and ice fishing use in the winter, but exact visitor counts are not available as such users are not required to register.

VISITOR USE IN THE 1970's

Presented in Table 1 is a history of public use of the Allagash from 1966 through 1977. Total use flucuated from a low of just under 26,000 visitor days[2] in 1968 to a high of over 50,000 visitor days in 1973. However, the number of parties and number of persons has generally increased annually since 1966 with highs of over 2,600 parties and 9,700 persons in 1978. A decreasing average length of stay and a decreasing party size are the primary reasons for less total visitor days than might be expected. Persons per party peaked in 1972 at 5.23 while average length of stay was highest in 1968 and 1970 at 6.85 and 6.83 days respectively.

Factors Influencing Use

Though the Allagash became State administered in 1966, annual visitor use remained about the same through the 1969 season. In July, 1970, the Allagash was officially designated, in a ceremony at Churchill Dam, as the first State administered federal wild and scenic river. This designation, with subsequent national publicity, appeared to generate a steady increase in use from 1970 through 1973. In 1974, the first gasoline shortages were felt in the United States. Subsequent spot shortages and a major shortage again in 1979, may have been factors in decreasing use from 1974 through 1976 and maintenance of a fairly constant level of use from 1977 through 1979.

---

[1] Paper presented at the National Outdoor R creation Trends Symposium, Durham, NH, April 2-23, 1980.

[2] Defined here as 24 visitor hours, which may be aggregated continuously, intermittently, or simultaneously by one or more persons. Total visitor days is the product of number of visitor times average length of stay.

[illegible]

Calendar Year	Number Parties	Number Persons	[illegible]	[illegible]	Total Visitor Days
1966	1,011	4,141	4.10	6.52	27,008
1967	1,065	4,539	[illegible]	5.91	26,831
1968	884	[illegible]	4.28	6.85	25,921
1969	1,134	4,820	[illegible]	6.17	29,720
1970	1,251	[illegible]	4.36	6.83	37,303
1971	1,492	6,345	4.25	5.72	36,274
1972	1,579	8,260	5.23	5.20	42,952
1973	1,877	8,337	4.44	6.04	50,361
1974	1,684	7,477	4.44	6.06	45,294
1975	[illegible]	9,447	3.94	4.60	43,503
1976	2,356	8,619	3.66	4.74	40,834
1977	2,489	9,278	3.73	5.04	[illegible]
1978	2,664	[illegible]	[illegible]	4.82	[illegible]
1979	2,392	8,932	3.73	[illegible]	[illegible]

[a] No data [illegible]

Gasoline availability is not the only factor influencing use. Summer weather patterns can cause a fluctuation in use from year to year as can the publication of feature articles in national magazines. In an effort to maintain or reduce use levels, the Bureau of Parks and Recreation requested, in the early 1970's, that use of the Allagash Waterway not be promoted by State agencies. This request has been honored, but some publicity still occurs through private sector promotion.

The Bureau has instituted two other measures that help control use. A group size restriction of no more than 12 persons per party was instituted in 1974 and a fee system of $1.00 a night for residents and $2.00 a night for non-residents (children under 15 free) was instituted in 1975. The fee system was also instituted to help defray operation and maintenance costs.

By instituting these measures, the Bureau hopes to avoid the necessity of a reservation system to keep visitation at acceptable levels during the peak months of July and August. Efforts will continue to spread use equally among designated sites and throughout the visitation season. Oversized groups of 13 persons or more (commercial guides utilizing the Waterway for three consecutive years before the 1974 regulation went into effect are still allowed to guide oversized parties) are generally required to utilize certain designated group campsites (which are off the general route of travel) to lessen impact on smaller parties.

Results of Visitor Surveys

Three surveys of visitors have been conducted in the Allagash:

- a 1966 survey by the Bureau of Forestry;
- a 1973 survey of all 1,877 parties using the Waterway in that year by the Bureau of Parks and Recreation; a
- a 1978 survey of 1,309 parties (about 50 percent of those using the Waterwa by the Bureau of Parks and Recreation

A summary of major trends is presented in Table 2. 1966 results are not directly comparable because the questions were asked and worded differently.

Table 2
Allagash Use Trends

	1966[a]	1973	1978
Maine Parties - percent of total parties	63	48	51
Fishing Parties - percent of total parties	72	33	30
Canoe Parties - percent of total parties	25	23	27
Parties taking thru trip (to Allagash Village) - percent of total parties	18	30	39
Fishing Parties - percent Maine led	-	78	81
Canoe Parties - percent Maine led	-	20	28
Visitor day impact of parties of 12 or more persons - percent of total visitor days	-	30	15
Percent of parties visiting Allagash Lake	4	5	5

[a] 1966 questions were phrased and administered differently than those asked in 1973 and in 1978.

Parties originating in Maine constitut about 50 percent of all parties visiting th Allagash. There appears to be a trend towards increasing visitation by Maine residents, despite a slight decrease in fishing and a slight increase in canoeing (canoeing parties tend to be led by out-of-state residents). However, the percent of Maine led canoeing and fishing parties are both i creasing.

The primary purpose of visitation is closely correlated to the month of visitati Fishing is by far the primary purpose of parties visiting the Allagash in May while canoeing is the primary purpose of August visitors. The majority of July visitors ar there for the combined purpose of fishing a canoeing.

Parties of 13 or more accounted for 30

rcent of the total visitor day impact in
73. Today, primarily because of the group
ze restriction imposed, they account for
ly 15 percent of the impact. This per-
ntage should decline over the years as
mmercial guides, excepted when the 1974
striction was imposed, eventually cease to
ide parties in the Allagash.

The primary destination of the majority
Allagash parties is Allagash Village.
shing parties seek the large lakes, however,
pecially Eagle Lake, while day use parties
equent the Michaud Farm area. Canoeing
rties are most likely to pursue the
rough trip to the Allagash Village area.

The major entry point of Waterway parties
Chamberlain Bridge, followed by Telos
nding and Indian Stream. In 1978, 2.4
rcent of all parties entered the Waterway
om the West Branch Penobscot watershed;
e majority of these entered via the Mud
nd portage to Mud Pond. In 1973, about
percent of the parties entered from the
t Branch Penobscot watershed.

THE ALLAGASH IN THE 1980's

Will concern with the potential of over-
of the Allagash continue into the 1980's?
answer to this question will probably be
y dependent upon the continued availability
an adequate supply of gasoline for auto-
ile travel, the continued popularity of
derness oriented canoeing, and whether or
the Dickey-Lincoln reservoir is construct-
Gasoline shortage and rising prices are
dicted to continue. That in itself may
enough to forstall the need for additional
siderations, such as a reservation system,
control use in the Allagash.

Can the opportunities and experiences
ered the Allagash user be enhanced? A
eral concept plan was completed for the
agash in 1973. That document addressed
presented recommendations relating to
tes of access, the control of bridges, use
location of control stations, user reg-
tions, the location and maintenance of
psites, historical interpretation, the
agement of sporting camps in the Waterway,
ety and rules enforcement, information
publications, staffing, and forest re-
rce management. The 1978 user survey
nd, for instance, that the tramway was
of the most popular points of interest
the Waterway. The 1973 plan recommended
t the tramway area and the locomotives
the area be restored, maintained, and
erpreted for increased user enjoyment.
Bureau has investigated this possibility
will pursue greater interpretation.
toration and maintenance appear to be uneconomical.

Other recommendations from the 1973 plan, and from the 1973 and 1978 surveys, which might enhance user enjoyment include continuing to limit the number of bridge crossings to no more than are now present and to locate them in such a manner as to reduce the visual impact of logging traffic; continuing to encourage the use of biodegradable containers and packaging by visitors and a carry-in, carry-out policy; continuing group size restrictions to protect both the wilderness character of the Waterway and the social impact on smaller parties; rotation of overused campsites to allow ground vegetation to recover; continued restrictions on size and use of outboard motors; continued management of Nugents Sporting Camp on Chamberlain Lake as long as it maintains its present character; management of the land bordering the Waterway in a natural state except as otherwise specified in the Waterway Act; the provision of a few additional campsites in certain overused areas to meet present demand (primarily the Churchill Lake/ Dam area and Allagash Falls area); and the provision of a central camping/staging facility in the Telos Lake/Chamberlain Bridge area if present overnight use demands continue or increase.

Some of these recommendations can be implemented without increased staffing or budgeting. Others will require additional monies which are difficult to obtain at this time. If needs are pressing, these monies will be sought. It is likely, however, that in the 1980's emphasis will be on implementation of management recommendations to increase use enjoyment, rather than recommendations requiring additional funding.

A continued concern in the 1980's will be the management of Allagash Lake as a remote wilderness area. Allagash Lake has primarily been used for fishing. A special 1979 survey of Allagash Lake users indicated that almost 82 percent of the visitor days incurred at the Lake were by fishing parties. Over 52 percent of the users entered the Lake via Johnson Pond/Stream while almost 25 percent came up by Allagash Stream and almost 14 percent entered using the Allagash Carry Trail.

The Bureau of Parks and Recreation is cooperating with the Department of Inland Fisheries and Wildlife to determine fishing pressures on the Lake. These studies will continue until Fish and Wildlife can determine what measures need to be taken, if any, to maintain or enhance the fisheries of Allagash Lake. Continuation of the remote, wilderness characteristics of Allagash Lake will be a major objective in the 1980's.

ASSESSING CHANGES IN THE IMPORTANCE OF TOURISM IN THE NORTHEAST[1]

Tommy L. Brown
Department of Natural Resources
Cornell University

INTRODUCTION

It is widely acknowledged that tourism is vital component of the economy of counties nd states in the Northeast, as well as in other egions of the US. Nearly all states claim ourism as one of their three largest industries. Yet data which accurately measure ourism and its economic impacts are woefully acking.

A number of data sources serve as useful ndicators of tourism levels. Visits to state nd national parks and other recreation areas, ut of state hunting and fishing license sales, nd boat registrations are examples. These ata are useful indicators of levels of travel, ut they provide little information on the conomic impacts of tourism.

In response to the gasoline shortages and ncreased prices that first began in 1973-74, federally funded regional research project of ne Northeast Agricultural Experiment Stations, E 100: "Recreation Marketing Adjustments in ne Northeast", was formed. This project had s its objectives the examination of changes in ecreation activity patterns by households in ne Northeast, and the impacts of changes in ecreation/travel patterns on subregional conomies. This paper examines the indicators f economic change related to tourism that are erivable from secondary data sources.

EVALUATION OF SECONDARY DATA SOURCES

Data sources useful to this effort had two equirements: comparable economic data by tates and substate units throughout the Northast, and data for at least two time periods. ecause of differences in the collection and eporting of employment and sales data by state bor and tax departments in the Northeast, these potential data sources were not acceptable for this effort. National data sources were then examined. Three data sources, all published by Bureau of the Census, proved potentially useful to the study: The Census of Retail Trade and the Census of Selected Services, published in 1972 and 1977, and County Business Patterns, published annually.

Each of these data sources reports the number and size of firms by Standard Industrial Classification (SIC) codes. The Census of Selected Services includes lodging data and other amusement and recreation services (e.g., movies, bowling alleys, race tracks), while the Census of Retail Trade includes such sectors important to tourism as sporting goods stores and bicycle shops, eating and drinking places, and gasoline service stations. County Business Patterns reports all of the above sectors. The Censuses of Retail Trade and Selected Services are more complete in their coverage, in that they utilize Internal Revenue Service and Social Security Administration data on small firms, including those with no employees. County Business Patterns, on the other hand, restricts its coverage to employment covered by the Social Security Program, excluding the self-employed.

Censuses of Selected Services and Retail Trade provide data on the number of firms, annual sales or receipts, and number of paid employees for the week of March 12. Obviously March 12 is a poor time choice for assessing impacts of tourism. County Business Patterns has provided annual payroll data only since 1974. Number of establishments and number of employees the week of March 12 have been provided annually since 1964. However, due to changes in data collection procedures, paid employee data is not comparable prior to 1974.

The difficulty in utilizing these data sources to evaluate the changing importance of tourism is reflected in the categories in which the data are reported, and in the inherent

---

resented at the Recreation Trends Symposium, urham, New Hampshire, April 21-23, 1980.

difficulty in measuring tourism. With the exception of the lodging sector, the clientele of other retail firms serving tourists also serve local residents. Moreover, the proportion of sales to local residents is often in excess of that to tourists. As a result, differences in tourism-related sales by a given restaurant or sporting goods store from year to year can easily be masked by changes in sales to local residents, if the latter trends in the opposite direction from the former. The author has experienced this problem in studies of the impact of salmon fishing in New York (Brown, 1975).

Kahn (1975) correctly points out that the lodging sector is not exclusively tourism-oriented in that restaurant facilities and meeting rooms receive local as well as tourist trade. However, unlike such major tourism sectors as restaurants and service stations, the majority of the volume in the lodging sector is tourism-derived. This is particularly the case in rural areas, which is the focus of the NE-100 study.

As a result of the above problems, it is the author's conclusion that comparisons of lodging statistics provide the best indication of changes or differences in economic impacts of tourism. This is in contrast to the use of many sectors in an analysis of factors affecting regional employment in tourism by Ellerbrock and Hite (1980). It is justified, however, by the preceding discussion, plus the interrelated observations that (1) travel of any notable economic consequence to the destination community involves overnight lodging, and (2) overnight lodging is often the largest expenditure component of tourists at the travel destination. Therefore, this analysis is limited to an analysis of changes in the lodging sector in the Northeast.

Of the available lodging measures, the number of firms is the least valid trend measure. The replacement of several small firms by a few larger firms may give the erroneous impression that tourism has declined over time. The number of employees is a moderately sensitive measure, but due to the collection of data during the week of March 12, it has limited utility. Annual sales/receipts is the most sensitive measure of changes or differences in lodging-related tourism, and is therefore the primary measure used in this paper.

METHODS

In comparing the importance of tourism to several areas over a specified time period, two types of measures are useful. The first is a comparative measure of the relative importance of tourism to the economies of the areas served and an indication of whether the economies being compared are growing more dependent, or less dependent, on tourism on a relative basis. Th second useful measure is a quantitative compa ison among study areas of the magnitude of th industry, the relative change in the magnitud of the industry over time, and factors which relate to differences in growth rates.

A comparative measure of the relative importance of tourism to the economies of state and counties in the Northeast was achieved by developing location quotients for all states, and for counties in which secondary data were available. Described in some detail by Isard (1976), location quotients (LQs) can be developed for employment, income, sales, or other economic parameters. LQs compare the proportion of a smaller area's economy devoted to a particular sector to the analagous proportion for a larger geographic area, of which the smaller area is a component part. In compari a lodging receipts LQ of a county with its state, for example, an LQ of 1.0 indicates th the proportion of the county's total receipts or sales derived from lodging is the same as that for the state. If the LQ were 2.0, the proportion of all county receipts derived fro lodging would be twice that of the state.

For this analysis, lodging receipts LQs were developed comparing first states in the Northeast and then counties in the Northeast the Northeast as a region of the U.S. In dev oping the LQs, the broader economic measure t which the lodging sector is compared had to b chosen. The measure chosen was the total of receipts from all service sectors of the economy as represented by Bureau of the Census' Census of Selected Services. An alternative measure would have been the sum of receipts and sales for the service sector plus the retail trade sector.

The quantitative comparison between stat and counties was facilitated by using shift-share analysis. This technique has been described in detail by Dunn (1960) and Ashby (1964). It has previously been applied to employment data, but is equally valid when u with sales or receipts. After examining lodging receipts for 1972 and 1977, the net relative change is calculated for states and cou ties in the Northeast. The large number of counties in the Northeast makes further aspe of shift-share analysis impractical. At the state level, however, further analysis is undertaken to gain indicators of the degree which changes in lodging are attributable to regional growth, industrial mix or distribut of industries, and proportional share of tot lodging receipts. These concepts are furthe explained in the analysis.

1972-1977 STATE LEVEL LODGING ANALYSIS

Location Quotients

From Table 1, it is apparent that the Northern New England states of Vermont, Maine, and New Hampshire are tourism-dependent states, compared to the remainder of the Northeast. The proportion of the total service receipts (lodging, personal, business, automotive, other repair, amusement/recreation, dental, legal, and engineering/architectural/surveying services) of these states derived from tourism range from 2.54 (New Hampshire) to 3.88 (Vermont) times that of the Northeast as a whole in 1977. West Virginia and the District of Columbia are also notably above the average for the Northeast. Connecticut, New York, and New Jersey, on the other hand, are least dependent on tourism on a relative basis.

The 1977/1972 LQs in Table 1 provide an indication of whether states have become more dependent or less dependent on lodging, on a relative basis, during the 1972 to 1977 period. New York and the District of Columbia have increased their relative dependence on tourism by approximately 10 percent, while at the other extreme, Maine, Vermont, Connecticut and Massachusetts have grown less dependent on tourism by approximately 12 to 14 percent. Again, these are relative measures. The fact that a state has become less dependent on lodging on a relative basis may simply mean that other sectors of the economy have expanded.

Table 1. Location Quotient of States for Lodging Receipts with Respect to the Entire Service Ecomony of the Northeast, 1972, 1977, and 1977/1972.

STATE	1977	1972	1977/1972
Connecticut	0.72	0.83	0.87
Delaware	1.13	1.08	1.04
District of Columbia	1.65	1.52	1.09
Maine	2.96	3.45	0.86
Maryland	0.85	0.81	1.04
Massachusetts	0.96	1.08	0.88
New Hampshire	2.54	3.14	0.81
New Jersey	0.86	1.02	0.84
New York	0.83	0.76	1.10
Pennsylvania	1.16	1.29	0.90
Rhode Island	0.93	0.97	0.96
Vermont	3.88	4.48	0.87
West Virginia	1.66	1.82	0.91

Derived from Census of Selected Services, U.S. Bureau of the Census, 1972 and Census of Service Industries, U.S. Bureau of the Census, 1977.

Shift-Share Analysis

To facilitate the shift-share analysis, 1977 receipts were converted to 1972 constant dollars. Since inflation rates differ for various economic sectors and in various sections of the United States, an approximation of inflation for the lodging sector in the Northeast was obtained by maintaining a constant ratio of dollar receipts per lodging employee for the two years under comparison. This resulted in a 5-year inflation estimate of 40.4 percent, compared to the national estimate of 43.7 percent for the same period.

To a large degree, the absolute magnitude of the lodging industry in the Northeastern states is a reflection of the size of those states. New York, Pennsylvania, New Jersey, and Massachusetts were the leading states in total lodging receipts in both 1972 and 1977. From Table 2, Column 8, it is apparent, however, that the greatest relative growth in lodging occurred elsewhere. The southern portion of the region (Delaware, Maryland, West Virginia, and the District of Columbia) experienced real growth in excess of 20 percent from 1972 to 1977. Maine's percentage growth of 12.6 percent was above the regional average of 6.7 percent, but New Hampshire and Vermont experienced real growth of less than three percent. Real growth in lodging was positive in every state in the Northeast from 1972 to 1977, but was least in New York and New Jersey, where it was less than one percent.

Columns (3), (4), and (5) of Table 2 allow further perspectives of the growth in the lodging sector from 1972 to 1977. From 1972 to 1977, in constant dollars, the Northeast retail economy declined by 2.34 percent in the level of sales and receipts. Column 3 indicates the change in lodging receipts each state would have experienced had lodging receipts grown (in this case, declined) as the rest of the economy. Lodging thus was one of the growth industries during this five year period of slight recession.

The industrial mix component (Column 4 of Table 2) is a measure of the mix and growth of the lodging industry in the region compared to other industries in the regional economy. It is calculated by multiplying 1972 receipts of each state by the difference in percentage change of the lodging industry and the entire retail economy of the Northeast from 1972 to 1977. Since the lodging sector of the Northeast increased by 6.7 percent and the regional economy declined by 2.3 percent, each state's 1972 lodging receipts totals are multiplied by the factor 9.0 percent, yielding a positive industrial mix for each state. Column 9 of Table 2 proportions the lodging industry mix among the states.

The state shares component (Column 5 of Table 2) is sometimes referred to as the

Table 2. Shift-Share Analysis for Lodging Receipts in the Northeastern United States, 1972 to 1977.

			Changes Related to:				
State	1977 Receipts	1972 Receipts	Regional Growth	Industrial mix	State Shares	Total Change	Net Relative Change
	(Measured in Millions of 1972 Constant Dollars)						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Connecticut	87.8	81.1	-1.9	7.3	1.3	6.7	8.6
Delaware	23.9	19.4	-0.5	1.8	3.2	4.4	4.9
District of Columbia	158.1	123.2	-2.9	11.1	26.7	34.9	37.8
Maine	81.2	72.1	-1.7	6.5	4.2	9.1	10.7
Maryland	147.8	121.9	-2.9	11.0	17.8	25.9	28.7
Massachusetts	249.8	236.8	-5.5	21.3	-2.8	13.0	18.5
New Hampshire	72.2	70.3	-1.6	6.3	-2.8	1.9	3.6
New Jersey	278.3	277.6	-6.5	25.0	-17.8	0.8	7.2
New York	922.3	918.2	-21.5	82.8	-57.1	4.1	25.6
Pennsylvania	507.3	456.9	-10.7	41.1	20.0	50.5	61.1
Rhode Island	25.7	23.2	-0.5	2.1	1.0	2.5	3.1
Vermont	60.3	59.0	-1.4	5.3	-2.6	1.3	2.7
West Virginia	70.9	58.0	-1.4	5.2	9.0	12.9	14.3
Northeast Region	2,685.6	2,518.7	-58.9	226.9	0	168.0	226.9

Percentage Changes, 1972 to 1977

	Percent Real Change	Percent Industrial Shift	Percent State Share Shift
	(8)	(9)	(10)
Connecticut	8.2	3.2	1.5
Delaware	22.9	0.8	3.8
District of Columbia	28.4	4.9	32.2
Maine	12.6	2.9	5.1
Maryland	21.2	4.8	21.4
Massachusetts	5.5	9.4	-3.4
New Hampshire	2.7	2.8	-3.3
New Jersey	0.3	11.0	-21.4
New York	0.5	36.5	-68.7
Pennsylvania	11.0	18.1	24.0
Rhode Island	10.9	0.9	1.2
Vermont	2.3	2.3	-3.1
West Virginia	22.3	2.3	10.9
Northeast Region	6.7	(99.9)	(100.1)(-99.9)

regional component (in national research) or the proportionality component. It is a measure of the degree to which each state has increased or decreased its "share" of regional lodging receipts. It is calculated by multiplying each state's 1972 lodging receipts totals by the difference in percentage change of the state's increase and the region's increase in lodging receipts from 1972 to 1977. In constant dollars the District of Columbia, Pennsylvania, and Maryland were the big gainers, while New Yo was the big loser. These state shifts are shown as a percentage of total positive and negative shift in Column 10 of Table 2. Thr fourths of all positive state shifts were accounted for by the three gaining states cited above, while 86 percent of the negati shifts were absorbed by New York and New Jers

The total change in lodging receipts from 72 to 1977 (the sum of Columns 4 and 5) is own in Column 6 of Table 2. This is also mply the difference between 1972 and 1977 dging receipts, in constant dollars. Again, l states experienced positive growth, ranging om $0.8 million in New Jersey to $50.5 mil- on in Pennsylvania (in 1972 constant dollars).

The net relative change (Column 7 of Table is the difference between the total change d the regional growth (Columns 3, 4, and 5). nce the regional growth of the Northeast onomy was negative from 1972 to 1977, net lative change data exceed total change data magnitude.

1972-77 COUNTY LEVEL ANAYLSIS

Based on county-level data from the 1972 d 1977 Census of Selected Services, location otients (LQs) were calculated as previously plained for lodging receipts, comparing the oportion of counties' lodging receipts vs. tal service sector receipts to that of the rtheast region. These data were then mapped.

It should be pointed out that while LQs volve around an index base of 1.0, an average all county lodging receipts LQs is consider- ly above 1.0 (it was 2.39 in 1977). This is ue for several reasons. First, the lower und on an LQ is 0, while there is no mathe- tically dictated upper bound. Secondly, the rge cities of the Northeast, which control a rge proportion of the total regional economy, nsistently have LQs of considerably less than 0, which increases the LQs of counties with aller economies. Finally, the counties for ich lodging data are not available are imarily those which do not have a developed urist economy; thus the average for counties ving available LQs is increased somewhat.

Approximately 30 counties in the Northeast d LQs of greater than 5.0. Many of these unties are in areas of the Northeast tradi- onally known to be tourism areas - coastal eas of Maine, the White Mountains of New mpshire, the Adirondacks and Catskills of w York, Cape Cod, Nantucket, and Martha's neyard in Massachusetts, Cape May in New rsey, the southern Maryland coast, the Pocono untains of Pennsylvania, and the Allegheny untains of West Virginia. Scattered counties sewhere in Pennsylvania and Vermont also have dging receipts LQs of greater than 5.0 igure 1).

If we examine counties in the Northeast th lodging LQs of greater than 2.0, the pendence of the northern portion of the gion on tourism becomes obvious. Virtually all of Northern New England and Northern New York fall within this grouping. Numerous counties appear in the rest of the region as well, particularly in the lightly populated coastal areas.

Figure 2 shows the 1977/72 LQs for the Northeast. Scattered counties which had high 1977 LQs increased their relative dependence on tourism from 1972 to 1977. A number of other rural counties showed a relative increase in the lodging sector as a proportion of total services of 10 percent or more.

Indications of absolute change in lodging receipts in constant dollars from 1972 to 1977 can be obtained from Figure 3. Receipts in many traditional tourist areas increased by better than 10 percent, some by more than 25 percent. Lodging receipts also increased by greater than 10 percent in some nontraditional areas, such as the Buffalo, New York area. Lodging receipts declined in real dollars, however, for many Northeastern counties from 1972 to 1977. A disproportionate share of these counties are located in Massachusetts, but these counties are interspersed throughout the entire region.

SUMMARY

One of the great frustrations of tourism analysts has been the lack of availability of trend data. This problem still exists, although the Census of Selected Services' measure of annual lodging receipts is an important indicator of tourism at the state and county level. This data source would be greatly improved if the 1982 survey avoided the disclosure problems that resulted in so much missing data at the county level in 1972 and 1977. There are very few counties in the Northeast which have so few lodging facilities that lodging summary statistics at the county level would provide implications as to the size of a particular firm.

This study has been largely devoted to evaluating secondary data sources and methods for analyzing secondary tourism data. The delineation of states and counties in the Northeast which are highly dependent on tourism, or which have experienced changes in the levels of tourism receipts, and the quantification of those parameters have provided an initial step in improving our understanding of tourism in the Northeast. Further analysis is needed to explain the tourism patterns described in this study. A new Northeastern regional project has been proposed to State Experiment Station directors which, if funded, would continue this analysis.

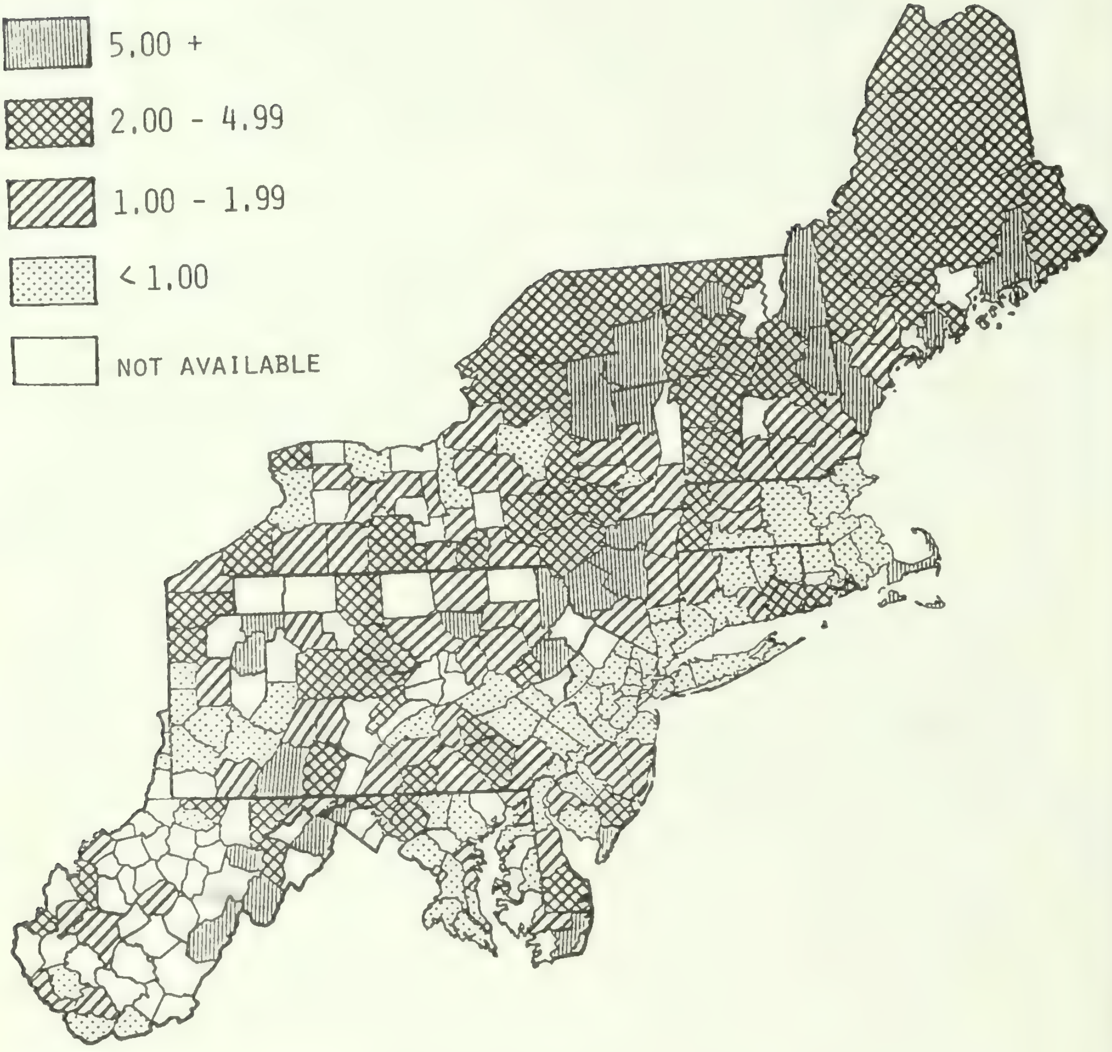


FIG. 1. 1977 LOCATION QUOTIENTS FOR LODGING RECEIPTS FOR COUNTIES IN THE NORTHEAST.

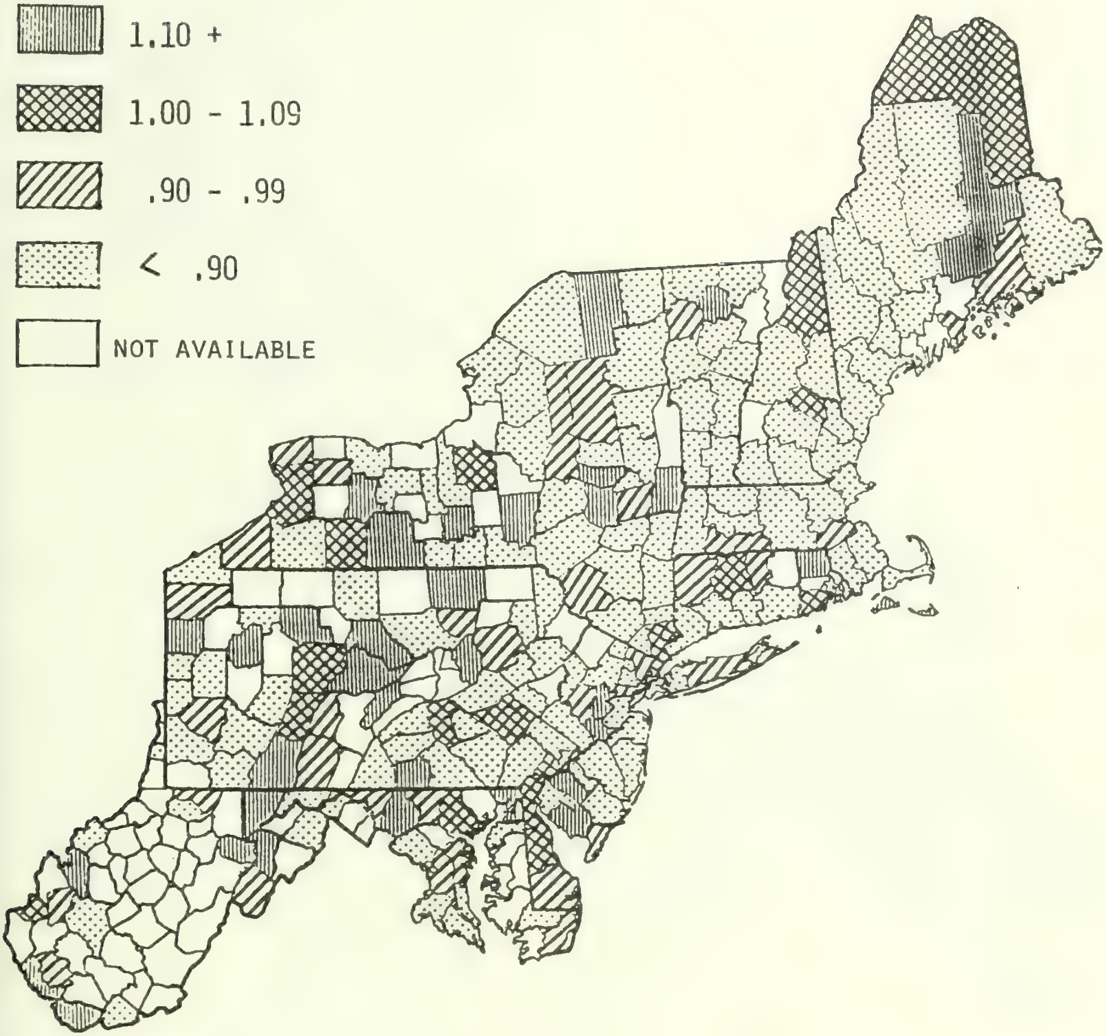


Fig. 2. 1977/1972 Location Quotients for Lodging Receipts for Counties in the Northeast.

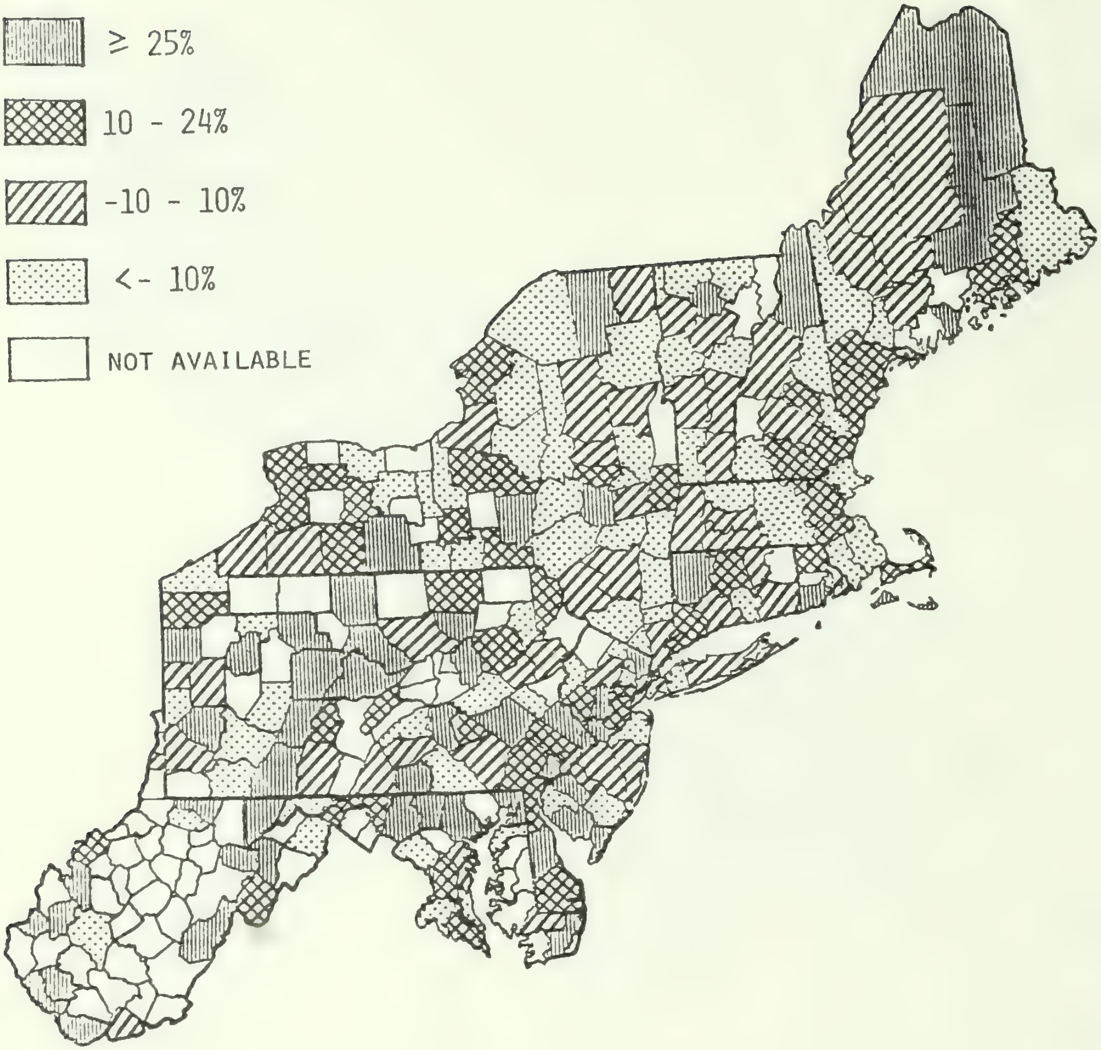


Fig. 3. Net Percentage Change in Lodging Receipts for Counties in the Northeast, 1972 to 1977.

LITERATURE CITED

Ashby, L.D., 1964. The Geographical Redistribution of Employment: An Examination of the Elements of Change, Survey of Current Business. U.S. Dept. of Commerce, Office of Business Economics, October, p. 13-20.

Brown, T.L., 1975. The 1973 Salmonid Run. New York's Salmon River Sport Fishery, Angler Activity, and Economic Impact. New York Sea Grant Institute publication NYSSG-RS-75-024. 26pp.

Dunn, E.S. Jr., 1960. A Statistical and Analytical Technique for Regional Analysis. Papers and Proceedings of the Regional Science Association, Vol. 6, 97-112.

Ellerbrock, M.J. and J.C. Hite, 1980. Factors Affecting Regional Employment in Tourism in the United States. Journal of Travel Research, Winter, 26-31.

Isard, W., 1976. Methods of Regional Analysis. The M.I.T. Press, Cambridge, Mass., Tenth Printing, 784pp.

Kahn, T.D., 1975. Estimating Tourist Industry Employment: The Primary Data Approach. Sixth Annual Travel Research Association Conference Proceedings, 167-174.

U.S. Bureau of the Census, 1972. Census of Selected Services. U.S. Government Printing Office.

U.S. Bureau of the Census, 1977. Census of Service Industries. U.S. Government Printing Office.

A METHOD FOR EXPLAINING TRENDS IN RIVER RECREATION DEMAND

George L. Peterson[1]
David W. Lime[2]
Dorothy H. Anderson[3]

Abstract.--Data being collected by The National River Recreation Study (NRRS) (U.S. Forest Service, St. Paul) includes origin-destination information for recreational visits to a variety of rivers nationwide. Such data are being collected over several years during a time of rapidly changing energy costs, economic conditions and consumer attitudes. This presents an opportunity to explain trends in river recreation demand. Methods of site choice and site demand analysis may be useful for this purpose. Appropriate mathematical models are defined and explained. It is shown how these models can be used to explain demand and predict trends.

INTRODUCTION

The primary thesis of this paper is that while it is useful and necessary to describe and project recreation trends, it is more powerful and efficient if they can be explained and predicted.

To describe a trend is to observe it and draw a picture of it - How have things changed in the past and what changes are occurring now? To project a trend into the future is to assume a kind of uniformitarianism - that the future will march to the same drummer as the past - that the river of time on which we paddle our frail canoes has no surprises around the bend.

We are advised by voyageurs of old who paddled the Great Lakes in birchbark canoes, "If you do not wish to drown, stay close to the shore." This is good advice in planning and in paddling, but there are times when it is more efficient to cut across the bay. There are also gorges like that of the Churchill river as it flows toward Hudson Bay where, for miles on end, there is little chance of rescue or escape in the event of an upset. And, sometimes we are committed to such gorges or shortcuts before the "signs of the times" warn us of possible dangers ahead.

The strategy of watching the winds and currents of now and staying close to shore has saved many a voyageur (and many a government official). But, armed with a good map of the river and a scientific forecast of the weather, we can proceed somewhat more boldly, effectively and efficiently.

In our management of recreation resources, we cannot literally scout the rapids ahead. But, we can do some kinds of research that will allow contingency scouting. To explain a trend is to explain the data of the past and present by means of theories about the processes causing changes to occur. Such theories and models can be powerful aids to judgment.

A "trend" is "the general course or prevailing tendency or drift" of something over time. In the recreation business, public and private investors are concerned about trends in recreation demand, particularly when those trends affect the consequences of lumpy capital investments or major commitments of natural resources. Failure to recognize trends in demand may cause today's "unwise" decisions to become tomorrow's foolishness. This is particularly unfortunate when such foolishness cannot easily be undone.

---

[1] Professor, Department of Civil Engineering, Northwestern University, Evanston, IL 60201

[2] Research Social Scientist, USDA Forest Service, North Central Forest Experiment Station St. Paul, MN

[3] Geographer, USDA Forest Service, North Central Forest Experiment Station, St. Paul, MN.

It is therefore understandable that so much effort goes into the description and projection of trends. But, it is better, if the trends can be explained in terms of their underlying causes. It then becomes possible to make conditional predictions, to analyze sensitivities, and, perhaps, even to control the trend rather than to chase it. The information revealed by trend explanation often leads to a double strategy which includes both modification of underlying causes of the trends and treatment of the symptoms of the trend itself.

The purpose of this paper is to discuss methods for explaining trends in river recreation. Emphasis is on the use of rivers for recreational travel by canoe, kayak, raft, innertube, etc., including the increasingly popular whitewater float trip. The framework used is generalizable, however. This kind of recreation has been increasing remarkably in recent years to the point that rationing and allocation schemes are being considered or implemented in some places. (Shelby, 1979)

The impact of increasing demand for free-flowing rivers has been complicated by another more basic trend: increasing demand for other uses of the river and its adjacent lands. The competing demands include domestic water supply, hydroelectric power, flood water retention, irrigation, industrial and manufacturing uses of water, waste disposal, and land development. Because of difficulties in demonstrating the benefits of recreation and because these competing demands for water are clearly linked to income, employment and economic development, they tend to get higher priority. This has created a trend of contracting quantity and quality of supply.

A reactionary trend based in public sentiment and political activism emerged in the late 60's and early 70's to produce 1) legislation such as the Wilderness Act, The Wild and Scenic Rivers Act, The National Environmental Policy Act, and the Wild and Endangered Species Act, 2) numerous ad hoc political skirmishes aimed at legislative preservation of specific free-flowing streams, and 3) a presidential call for examination of the stream-flow requirements of recreation (Carter, J. 1978).

In the midst of this exciting and perplexing ferment of contradictory demands and trends, the 1970's introduced two profound intervening factors: energy shortage and two-digit inflation, possibly leading to shrinkage of real income. Gasoline prices have quadrupled in five years. What affects are these changes having on the quantity, geographic distribution, and social distribution of demand for river recreation? What new trends, if any, are developing, and what can be predicted for the future? Can the changes reveal useful information about the demand process so that resources can be managed more effectively and future changes anticipated?

The National River Recreation Study (NRRS) being conducted by the North Central Forest Experiment Station (Lime, et. al. 1979) may be able to help answer such questions. Beginning in 1977 data have been collected so far on the recreational use of 39 different rivers nationwide, including origin and destination data on travel to and from the rivers. Some of the rivers have been monitored for two and three years, thus providing the possibility of analysis of trends.

Theoretical Framework

A useful theoretical framework can be developed from the following assumptions:

1. The set of rivers (j=1,2,---,r) represents the nationwide spectrum of river recreation opportunities.

2. For person n residing at location i the utility or net benefit produced by a visit to river j is

$$ {}_{n}U(ij) = {}_{n}u(X_{1ij}, X_{2ij}---, X_{gij}, ---, X_{pij}) + {}_{n}\epsilon_{ij} \qquad (1) $$

Where x_{gij} is the magnitude of variable g experienced by person n during a visit to river j The x's may include travel cost, site use fees, river characteristics which influence the suitability of the site for the purpose in question (deBettencourt, 1979). ${}_{n}u$ is the systematic or predictable function by which utility is sensitive to x. The residual ${}_{n}\epsilon_{ij}$ is random "error" and is assumed to be independently and identically distributed for all rivers according to the Weibull distribution with dispersion parameter λ. (McFadden, 1978)

3. Interpersonal and inter-situational differences in ${}_{n}u$ can be captured effectively b a set of market segments or person types. To simplify the discussion, notation designating person or person type will be dropped. The utility function will be designated simply by

$$ U(ij) = u(x_{1ij}, x_{2ij}---, X_{gij}, ---, x_{pij}) + \epsilon_{ij} \qquad (2) $$

with the understanding that it may vary by market segment. The utility function may vary al by activity or purpose of visit (e.g., kayakin canoeing, rafting), but for simplicity it may assumed only one activity is considered.

4. When a person engages in the recreational activity in question, that river is chosen which maximizes utility.

Based on these assumptions and given participation in the specified activity, the probability that a person residing at location i will choose river j is

$$\hat{P}(j|i) = \frac{e^{\lambda U(ij)}}{\sum_{k=1}^{r} e^{\lambda U(ik)}}. \qquad (3)$$

This is a logit choice model (Domencich & McFadden, 1975). It can be estimated by maximum likelihood methods if the form of the utility function is specified and data are available on individual choices and the magnitudes of the x's experienced.

This kind of model is generally called a "site-choice" or "trip-distribution" model. It explains the proportion of total demand each site will receive, but it does not explain the magnitude of demand. The number of visits delivered by location i to river j is

$$V_{ij} = P(j|i) \sum_{k=1}^{r} V_{ik} = \frac{e^{\lambda U(ij)}}{\sum_{k=1}^{r} e^{\lambda U(ik)}} \sum_{k=1}^{r} V_{ik}, \qquad (4)$$

Where $\sum_{k=1}^{r} V_{ik}$ is the total number of visits from location i to all rivers. In order to explain the magnitude of site demand, it is thus necessary to explain $\sum_{k=1}^{r} V_{ik}$. This is a "trip-generation" problem.

There are several ways trip-generation might be approached (Stopher & Meyburg, 1975). One way is to use a simple empirical model of the type proposed by Cesario and Knetsch (1976). Assume location i is a geographic area containing a finite number of people P_i, of the type in question. Assume also that the average number of river trips per person is a function of the total supply of opportunities. The denominator of the trip distribution logit model (3) measures the condition of supply from the point of view of i. A plausible hypothesis is

$\mathcal{E}$(River trips per person)

$$= \frac{\sum_{k=1}^{r} V_{ik}}{P_i} = b_o \left[\sum_{k=1}^{r} e^{\lambda U(ik)}\right]^{b_1} \qquad (5)$$

$$\text{or} \quad \sum_{k=1}^{r} V_{ik} = b_o P_i \left[\sum_{k=1}^{r} e^{\lambda U(ik)}\right]^{b_1}. \qquad (6)$$

Given this relationship, the site demand function becomes

$$V_{ij} = \frac{e^{\lambda U(ij)}}{\sum_{k=1}^{r} e^{\lambda U(ik)}} b_o P_i \left[\sum_{k=1}^{r} e^{\lambda U(ik)}\right]^{b_1}. \qquad (7)$$

An alternative approach which is conceptually more general is the nested choice model (McFadden, 1978). The choice process might be decomposable into several conditional demand allocation stages: 1) choice of recreation site given recreation activity, 2) choice of recreation activity given that time is allocated to recreation, and so on. If the utility function is separable by site variables, activity variables, etc., a logit model can be derived which explains $P(j,\beta,---)$, the probability of choosing site i and activity β and --- etc. Activity variables might include "psychological outcomes" (Driver and Brown, 1975) as used by Peterson et al., (1978) to explain activity choice. However, for use in prediction, even a two-stage model requires knowledge of all sites for all activities. In all but very simple cases of two or three choices in each stage, the model becomes impossibly complex and data hungry. With simplifying assumptions, it might be feasible to develop a model of this type which requires specific knowledge of site attributes only for river recreation. This is a subject for another paper, however. The approach used here is based on equation (7), with the understanding that more powerful models may be possible.

The Single River Case

Equation (7) shows the demand for one river to be a function of the characteristics of all rivers with which the river competes. Consider the special case of a river with no competitors. This situation might exist, for example, when the users of a particular river include a subgroup of people whose choice set contains only that river. Some rivers, such as the Colorado River in Grand Canyon National Park and the Middle Fork of the Salmon River in Idaho may be so unique they compete with other rivers only in the sense they compete with movies or trips to Europe. A certain river may have local geographic monopoly such that virtually all the visitors use that and only that river for the activity in question. Or, we may choose to perform the analysis, given the choice of this river. In any case, the assumption of no competitors implies the parameters, models, and conclusions apply only to that river and cannot be generalized to other situations, because none comparable exist. With this understood, there are no dangers in single site analysis. For the single river case, equation (7) becomes

$$V_i = b_o P_i \, e^{b_1 \lambda U(i)} \qquad (8)$$

In general, the parameters of a single-site model such as equation (8) should not be estimated for one site and applied to another. Equation (8) derives from the assumption the rivers in question are not competitors. This may imply different utility functions and/or mutually exclusive populations for different rivers.

It is interesting to compare (8) with (7). Equation 7 can be stated as

$$V_{ij} = \left[\sum_{k=1}^{r} e^{\lambda U(ik)}\right]^{(b_1 - 1)} b_o P_i \, e^{\lambda U(ij)} \qquad (9)$$

or

$$V_{ij} = \gamma_i b_o P_i e^{\lambda U(ij)} = b_o P_i \, e^{[\ell n \gamma_i + \lambda U(ij)]} \qquad (10)$$

where γ_i is a function of the condition of total supply from the point of view of i. This comparison reveals an interesting conclusion. Even if b_o, b_1, P_i and U are universal for all rivers, substitutes or not, the single-site model (8) multiplies the utility function by b_1, the trip-generation exponent, while the multiple-site model (10) adds to the utility function an origin-specific supply function. Estimating equation (8) for one river and then applying the results to another river is an implicit assumption that $[\ell n \gamma_i + \lambda U(ij)] = b_1 \lambda U(ij)$. While this may be true under very restrictive conditions, in general the single site model clearly does not reveal generalizable information about sensitivity of demand to changes in variables in the utility function such as changes in fuel costs and site variables. While such an empirical model can explain demand and participation trends for a given river, it cannot explain or predict such trends under conditions different than those under which the data were observed. The magnitudes of the estimated "constant" parameters will change with changes in the variables.

On the other hand, using the multiple site model (7) or (10) for several non-substitutable rivers also has serious problems. As in (9) the market population from which each river draws its visitors may be different and/or the utility functions may be different. Such problems can distort the results seriously and lead to invalid conclusions if they are not recognized.

Thus, ability to predict changes in participation at specific sites requires for each river correct knowledge of a) the consumer utility function and b) the market population. If, for a given set of rivers, utility "errors" are identically and independently distributed over the market populations by the normal or Weibull distribution about a common utility function, equation (7) is an explanatory site demand function. If a river has no substitutes, equation (8) is an explanatory site demand function, but is not generalizable to other rivers.

Simple Illustrative Models

For illustrative purposes assume the predictable portion of the utility function contains only two variables,

D_{ij} = travel distance from location i to river j

A_j = a measure of the site quality at river j

The functional form most often used in logit models is the simple linear combination:

$$u = bo + b_1 A_j + b_2 D_{ij} \qquad (11)$$

This function assumes a constant marginal rate of substitution, which may be reasonable for narrow ranges of variation although it does not allow estimation of the dispersion parapmeter λ. From the point of view of economic theory, a more general form is

$$u = \alpha A_j^{\beta_1} D_{ij}^{\beta_2}. \qquad (12)$$

Another form with properties similar to (12) is

$$u = \ell n \, \alpha + \beta_1 \, \ell n \, A_j + \beta_2 \, \ell n \, D_{ij}. \qquad (13)$$

This form produces convenient algebraic simplification of the logit model. Equations (12) and (13) are appealing because they show diminishing marginal returns, but none of these forms is satisfactory when the marginal utility function is not single valued. For example, the attractiveness of a river for white-water canoeing is low for sluggish streams. As the white-water difficulty increases, attractiveness increases to a point and then begins to decrease again as the river becomes too difficult. Perhaps this is because the variable is a composite of several more basic variables, but, in general, it has proven useful to represent such relationships by a quadratic utility function (deBettencourt, 1979):

$$u = \alpha + \beta_1 A_j^2 + \beta_2 A_j D_{ij} + \beta_3 D_{ij}^2. \qquad (14)$$

Apparently there has not been much research done on the problem of specifying the best utility function in logit models or site-demand models. Most logit modellers seem satisfied by the assumption of (11), perhaps because utility is difficult to measure and the models robust. In any case, more research is needed on utility functions. At least the robustness of the models over different utility function forms needs to be studied.

To illustrate the kinds of information revealed for trend and impact analysis, assume the utility function has the form of (13) and distance is the only variable. The multiple site-demand model (7) is

$$V_{ij} = \frac{D_{ij}^{\lambda\beta}}{\sum_{k=1}^{r} D_{ik}^{\lambda\beta}} b_o(\alpha^{\lambda b_1}) P_i \left[\sum_{k=1}^{r} D_{ik}^{\lambda\beta}\right]^{b_1}. \quad (15)$$

The single-site demand model (8) becomes

$$V_i = b_o P_i \alpha^{\lambda b_1} D_i^{\lambda b_1 \beta}. \quad (16)$$

In estimation, the parameters cannot be decomposed and the two models are

$$V_{ij} = \frac{D_{ij}^{B_1}}{\sum_{k=1}^{r} D_{ik}^{B_1}} B_o P_i \left[\sum_{k=1}^{r} D_{ik}^{B_1}\right]^{b_1} \quad (17)$$

and $$V_i = B_o P_i D_i^c, \quad (18)$$

where B_o, B_1, b_1, and c are estimated parameters.

Given the assumptions and the multiple-site case (equation 17), the parameter B_1 describes the sensitivity of demand distribution to distance. The parameter b_1 describes the sensitivity of demand to the overall condition of supply. In the single-site case, C describes demand sensitivity to distance, but it is not generalizable to other sites.

Response of demand to changes in things like site attractiveness and fuel cost cannot be analyzed in (17) or (18). Changes in fuel cost would change the meaning of distance and would cause changes in B_1 and C. The impacts of changes in fuel price and other economic conditions would be better analyzed if D_{ij} were replaced by variables describing travel time, travel mode, fuel price, etc. The resulting equations would be more general and would explain the response of demand to changes in these variables. Likewise, variables describing the specific site attributes to which site attractiveness is sensitive should be included in the utility function. This would explain the response of demand to specific changes at specific sites.

Illustrative Empirical Applications

Using only distance and population, the authors used a model based on the log-linear utility function, equation (13), to do single-site analysis for the Boundary Waters Canoe Area Wilderness in Minnesota. Under the assumption of no substitutes, the purpose was to estimate

$$V_i = B_o P_i D_i^C \quad (19)$$

for several different camping types of wilderness travelers: paddle canoeing, motor canoeing, motor boating, hiking, cross-country skiing, and snowmobiling. The purpose of the study was to describe the relative uniqueness of the site for different activity purposes by describing the geographic origins of visitors.

In order to eliminate biases resulting from possible differences in sampling rates, the equation was estimated in the following form:

$$P(ni) = P(i)P(n|i) = \alpha D_i^C e^{\epsilon_i} \quad (20)$$

where $P(i)$ = the probability that a visit randomly observed at the site is from origin i,

$P(n|i)$ = the probability that a visit randomly observed at the site is person n from origin i, given that the visit is from origin i and assuming all persons at origin i are equally likely to visit the site.

$P(ni)$ = the joint probability that a visit observed randomly at the site is person n from origin i, assuming all persons from origin i are equally likely to visit the site.

ϵ_i = an error or residual that is assumed to be independently and normally distributed with constant variance over the range of analysis.

Estimates of these probabilities are

$$\hat{P}(i) = \frac{V_i}{\sum V_h} ,$$

$$\hat{P}(n|i) = \frac{1}{P_i}$$

$$\hat{P}(ni) = \frac{V_i}{P_i \Sigma V_h} .$$

Because equation (20) is a probability, its complete specification in the estimated form is

$$\hat{P}(ni) = \frac{D_i^{\,c}}{\Sigma P_h D_h^{\,c}} . \qquad (21)$$

This equation can be estimated by maximum likelihood methods. However, the simpler method of ordinary least squares applied to the log-linear form of equation (20) was used. The results are shown in Table 1.

Using National River Recreation Study data from 1977, Peterson, Lime, and Anderson (1979) estimated similar single-site equations for twelve rivers. The results are shown in Table 2.

With NRRS data for twelve rivers studied in 1978, (Ergün and Peterson 1980) estimated the following site choice model:

$$P(j/i) = \frac{e^{\beta D_{ij} + \zeta_j D_j}}{\sum_{k=1}^{r} e^{\beta D_{ik} + \zeta_j d_k}} . \qquad (22)$$

This logit model is based on the linear utility function

$$u = \beta D_{ij} + \zeta_j d_j \qquad (23)$$

Table 1
Single site Analysis for Six Uses of the Boundary Waters Canoe Area Wilderness
(Assuming no substitute sites for the respective activities)
(1974 - 1977)

Activity	Estimated Equation P(ni) =	Number of Trips in Sample	Number of Zones	Log-Linear R^2	Adjusted Log-Linea R^2
Paddle Canoeing	$(0.03)D_i^{-2.54}$	68,283	167	0.774	0.773
Motor Canoeing	$(0.16)D_i^{-2.86}$	10,195	119	0.745	0.743
Motor Boating	$(0.10)D_i^{-2.87}$	14,278	152	0.713	0.711
Hiking	$(0.19)D_i^{-2.93}$	2,483	62	0.813	0.810
Cross Country Skiing	$(4.13)D_i^{-3.47}$	365	14	0.816	0.801
Snowmobiling	$(64.31)D_i^{-4.13}$	422	12	0.907	0.900

Table 2
Single-Site Analysis for Twelve Rivers
(1977 Data)

River	Estimated Equation P(ni) =	Number of Trips in Samples	Number of Zones (i)	R^2	Adjusted R^2
ain Salmon	$(0.00096)D_i^{-1.78}$	175	27	0.735	0.724
iddle Fk. almon	$(0.0014)D_i^{-1.81}$	191	28	0.702	0.691
pper olorado	$(0.00083)D_i^{-2.02}$	2169	52	0.795	0.791
pple	$(0.00067)D_i^{-2.03}$	191	26	0.753	0.743
antahala	$(0.0011)D_i^{-2.08}$	87	26	0.697	0.684
hattooga	$(0.0012)D_i^{-2.26}$	9877	77	0.728	0.724
llinois	$(0.0023)D_i^{-2.27}$	226	22	0.789	0.778
esChutes	$(0.012)D_i^{-2.48}$	456	18	0.797	0.784
coee	$(0.0061)D_i^{-2.61}$	280	23	0.875	0.869
ohican	$(0.0028)D_i^{-2.64}$	444	21	0.837	0.828
iwassee	$(0.035)D_i^{-2.87}$	128	12	0.858	0.844
pper issouri	$(1.26)D_i^{-3.03}$	497	32	0.911	0.908

here d_j is a site-specific dummy variable which takes on the value of one for river j and zero for all other rivers,

ζ_i is an estimated site-specific parameter capturing sampling and specification errors, including biases resulting from different sampling rates at different rivers.

β is the estimated marginal utility of distance.

he analysis was based on 4524 visits to the welve rivers from 377 three-digit zip-code ones. The estimate of β in equation 22 is .00167. The results clearly show distance to e an important explainer of demand distribution. simple market share model correctly predicts 0.9% of the trips. With the addition of disance to the model, this rises to 50.7%. Assignent of equal probabilities on the basis of no nformation whatever gives 8.3% correctly preicted. However, Ergün also found that β varies or the twelve rivers from region to region when he model is estimated on a regional basis. He lso divided the twelve rivers into two basic types and found differences in β by river type. This indicates the presence of effects not adequately captured by equation (21).

Discussion of the Empirical Results

Results presented in the preceding section are illustrative only. The equations are estimated under very restrictive assumptions. The estimation procedure, while simple, does not satisfy the condition that the probabilities must sum to one over all cases, which may introduce slight biases in the exponents and major biases in the coefficients. The coefficients should, in any case, be regarded with skepticism because of their extreme sensitivity to errors in estimation.

The most interesting bit of information is the exponent of distance. Given the hypothesized functional form (20), the exponent c is the distance elasticity of trip attraction. If the equation is constrained as in (21) the elasticity is c[1 - P(ni)]. However, P(ni) is likely to be an extremely small number except in the unlikely situation where the origin is very close to the destination, there are few nearby origins, and the population is very small. In any case the probability will always be less than the reciprocal of the population. The elasticity estimates the percent change in P(ni) when distance changes by one percent. Assuming that any estimation biases affect all equations in the same systematic way, comparison of the exponents between equations reveals relative differences in elasticity. It does not, however, reveal reasons for the differences.

While attempting to interpret the results, it is important to recall the assumptions under which the illustrative equations were estimated, especially:

1. The distance-decay of trip attraction is insensitive to conditions of competing supply,

2. There are no differences in site quality,

3. The population from which a site attracts its visitors is homogeneous vis-a-vis the systematic or predictable portion of the utility function, and inter-personal differences are randomly, independently, and identically distributed by the Weibull distribution, and

4. The market population is the entire population of the contiguous United States.

With these assumptions in mind, the estimated elasticities lead to the following comments and conclusions:

1. Trip attraction is very sensitive to distance and is strongly explained by distance alone.

2. On the average, the explained portion of log-linear variation among zones is about the same for the BWCAW (79%) as it is for the rivers (78%). There is little variation among all the equations in the amount of variance explained. There is apparently no cause to conclude that the model is more applicable in some cases than in others.

3. The distance elasticity varies among rivers and among different uses of the BWCA. This implies some "market areas" are more local than others, for whatever reason. Generally, the more elastic the demand, the more local the resource. It is interesting that the BWCA shows very different elasticities for different uses, which suggests that a site may be geographically more unique for some purposes than for others, i.e., it tends to reach out farther for some kinds of visitors than for others.

4. Because distance is closely related to travel cost and travel time, given travel mode, it should be possible to estimate models which explain the sensitivity of site demand to these variables. This will allow prediction of the response of demand at specific sites to changes in fuel cost and transportation technology, other things being equal.

5. It is not clear from the empirical results what the reasons are for the differences in exponents. Plausible causes are

a) differences in the benefit of an activity to its participants,

b) differences in the quality of a site for the given activity,

c) differences in the quality, quantity and relative location of competing sites and activities, and

d) differences in participation costs.

It is clear that differences exist. Further experiments are needed to isolate the causes so that demand can be understood and predicted and resources wisely allocated.

6. Although details are not reported here, examination of the residuals shows non-random geographic patterns (Peterson, Lime & Anderson, 1979). This implies other variables may be influencing the relationships systematically and their effects may be predictable, although the magnitude of their effects is less than the effect of distance.

The distance elasticity of trip distribution in equation (23) is $\beta D_i[1 - P(j|i)]$ where $\beta = -0.00167$. This is not comparable with the trip attraction elasticity, because they are different concepts and the utility function specifications differ. It is interesting to note, however, that when $P(j|i)$ is small, the distance elasticity of trip distribution has the range of -1.78 to -4.13 when distance has the range of 1066 miles to 2473 miles.

More important, though, is that the estimate of β is not stable when rivers are segmented by type and the population is segmented by area. This could be caused by incorrect specification of the utility function and/or aggregation error.

REFERENCES

Carter, J. (President), Water Policy Reform Message, July 6, 1978.

deBettencourt, J.S., "Threshold Theory and Methods for Assessing Environmental Performance Capability," Ph.D. dissertation, Northwestern University, Evanston, IL., 1979.

Domeneich, J. and D. McFadden, Urban Travel Demand: A Behavioral Analysis, North Holland Publishing Co., New York, 1975.

Driver, B.L. and P.J.Brown, "A Social-Psychological Definition of Recreation Demand," in Assessing Demand for Outdoor Recreation, USDOI-BOR and NAS, Washington, D.C., 1975.

Ergün, G. and G.L.Peterson, "River Site Choice Modelling," Northwestern University, Evanston, IL., 1980.

Lime, D.W., R.C. Knopf and G.L.Peterson, "The National River Recreation Study," 2nd Conference on Research in The National Parks, Nov. 26-30, San Francisco, 1979.

McFadden, Daniel, "Modelling the Choice of Residential Location," in A. Karlquist et. al., (eds.) Spatial Interaction Theory and Planning Models, North Holland Publishing Co., New York, 1978.

Peterson, G.L., A.Anas, F.S. Koppelman, P.R. Stopher, Prediction of Urban Recreation Demand, Northwestern University, Evanston, IL, 1978.

Peterson, G.L., D.W. Lime and D.H.Anderson, "Attraction of Recreationists to Rivers: A Nationwide View," 2nd Conference on Research in the National Parks, Nov. 26-30, San Francisco, 1979.

Shelby, B. and M. Danley,"Allocating River Use," Oregon State University, 1979.

Stopher, P.R. and A.H.Mayburg, Urban Transportation Modelling and Planning, Lexington Books, Lexington, MA. 1975.

TRENDS IN RECREATIONAL VEHICLE TRAFFIC IN NORTHEASTERN MINNESOTA[1]

Arthur Norton
Lake Superior Basin Studies Center
University of Minnesota, Duluth
Duluth, MN

Karen Noyce
Lake Superior Basin Studies Center
University of Minnesota, Duluth
Duluth, MN

Thomas J. Wood
Lake Superior Basin Studies Center
University of Minnesota, Duluth
Duluth, MN

INTRODUCTION

Many northeastern Minnesota communities epend upon outdoor recreation activities and ourism for a substantial portion of their early cash inflow. While the recreation and ourism industry in the region has grown teady in recent years, it may prove to be ess stable in the future than other indus- ries, for at least two basic reasons: (1) hile sociologists and recreation planners ay dispute the assertion, outdoor recreation s considered by many a luxury or a non- ssential activity and therefore subject to lteration of activity participation due to hanging economic status of families and ndividuals. (2) the recreation and tourism ndustry is dependent to a large part on a ighly mobile population. Because of these wo characteristics, recreation and tourism atterns can be subject to rapidly changing rends as a result of inflation, increasing nergy costs and gasoline availability.

To respond to data needs of program lanners and decision makers within the rec- eation and tourism industry, a recreational ehicle traffic monitoring program was im- lemented to determine if an easily conducted, tandardized count of traffic could adequately escribe patterns of recreational oriented ovement in and out of the Duluth area. The oniter was designed to identify: vehicles hat were most common; movement of boats, anoes, dirt bikes, skies, snowmobiles etc; eriods of high and low volumes; and changing atterns of movement.

In addition to the traffic monitor, existing supplemental data was expected to aid in determining the effect that external factors had on levels and patterns of recreational activity. While temperature, weather, season, events, and holidays were to be examined as potential impacts, the overiding concern of many people in the industry focused on spiraling gasoline prices and the potential of nonavailability of gasoline supplies.

Studies and theories concerning recreational traffic and response to gasoline restrictions both in Canada and Europe have been conducted by Dr. R. I. Wolf (1969,1977). Unavailability of fuel is thought to be a more potent force in restraining travel than its rising cost but there is little research that can support this contention. Wolf has found that there appears to be a change in travel patterns in Europe as a result of the continuing escalation in fuel costs or in its restricted availability. Europeans are turning toward public transportation to provide for their required travel to and from work and their social obligations, but reserve their private auto for travel to their recreational second home or their favorite recreation area. Will Minnesotans and their visiting neighbors respond similarly? This is what we wanted to know.

STUDY AREA

Duluth is located at the western tip of Lake Superior in northern Minnesota. It is a center of recreation for northern Minnesota and Wisconsin in its own right, but virtue of its beautiful harbor, adjacent Lake Superior, long ocean-like beach, cultural and retail opportunities and transportation linkages.

---

[1] Paper presented at the National Outdoor ecreation Trends Symposium, Durham, NH, April 0-23, 1980.

Expansion and new development of recreation opportunities is evident in Duluth. The Marine Museum, one of the most visited attractions in Minnesota, was expanded in 1978-1979. Cleanup of the picturesque and largely undeveloped St. Louis River which flows through the city has already begun; a new, advanced, waste-water treatment plant located on the river started operations in the fall of 1978. Several new hiking trails planned for 1980 are in some of Duluth's 110 city parks.

The recreation-tourism industry is a very important segment of Duluth's economy. Uel Blank reported that during 1972, visitors traveling through Duluth typically made expenditures equal to 28 percent of the city's total retail sales for a summer week. A yearly projection of non-resident vehicles had Duluth-Superior as their major destination and survey data indicated a conservative estimate of 3.8 million non-resident person-trips to Duluth-Superior for vacation purposes alone each year.

Duluth also serves as a gateway for much of the popular northwoods lake country. It is the largest retail center in the upper Minnesota-Wisconsin region, and thus serves the needs of travelers passing through (and is the destination of many Canadian shopping trips). In addition, the city's geographical position at the head-of-the-lake has led to the intersection of several highways through the city. Backpackers hiking down the main street of Duluth also is a common sight.

Northern Minnesota and Wisconsin have great recreation potential year-round, from fishing in the spring to boating in summer; hunting, fishing, and "leaf-peeping" during autumn; and snowmobiling and skiing in winter. Although summer may always be the busiest tourist season of the year, activity during the other seasons is on the increase. Thompson Hill Visiter's Center had its highest 1978 daily total on September 30th, during the height of the fall foliage season!

PROCEDURES

Interstate 35 south of Duluth was chosen for the traffic counts for two main reasons: first, it brings traffic primarily from the St. Paul-Minneapolis area and further south. Most people vacationing in northern Minnesota come from that direction. Secondly, it has one of the highest volumes of traffic entering Duluth from any direction and the highest percentage of out-of-state recreational traffic (Blank).

Friday afternoons from 1 to 5 p.m. were selected as the optimum counting period for this survey and is assumed to represent the beginning of the weekend recreational traffic period. In addition, Thompson Hill Informati Center (located near the observation station) hourly counts indicate that 1-5 p.m. on Fridays is the peak flow period of the week for visitors coming into the area. Counting any later in the afternoon was not possible during the winter months, and week-end traffi counts would have been more expensive and much harder to arrange. In any case, consistency seemed to be the crucial factor in conducting counts throughout the year, since whatever time period selected for counting would only represent a portion of the total weekly recreational traffic.

The traffic count tally sheets were designed to be inclusive of all types of visibl recreational traffic and as objective as possible. In some categories there were unavoidable errors, but these were felt to be relatively small and inconsequential. Recreational traffic was classified in two ways. First, counters noted the type of vehicle carrying or pulling recreational equipment, e.g. sedan, pickup, motorhome, four-wheel vehicle, van or other. Second, the type and number o recreational indicators were recorded such a boats, skis, camper-trailers, snowmobiles etc. Recreational equipment was further clas ified where appropriate, as either "warm-weather" or cold-weather" indicators.

Counting was begun in late July on a test basis. Official counting for this stud started August 5, 1977 and ended on July 27, 1979, two complete years of data. Separate counts were kept of northbound and southboun traffic for each hour. At the end of four hours of counting, the totals for each hour each direction were calculated.

Weather forecasts for each weekend were obtained from the National Weather Service o Friday morning. Any special tourist or recreational-related events occurring that weekend were also noted. Presence or absence of ice on Lake Superior and inland lakes was recorded, as well as the status of hunting an fishing seasons. Supplementary data obtaine from other sources were tabulated at the end of the count year. Such data included Thompson Hill Visitor Information Center inquirie Minnesota Department of Transportation traff averages, gasoline prices, hotel/motel occupancy rates, Amtrak passenger and recreation baggage totals.

RESULTS AND DISCUSSIONS

This study was initiated in August 1977

nd the first year report analyzed data ollected between August 1977 and July 1978. he first year report (Norton, Hales, and ood 1978) demonstrated that a standardized ount of recreational traffic can be made hat can reflect several trends in both ype and volume of recreational travel. uch counts were useful in isolating those vents and factors which significantly influnce recreational travel patterns. The econd year of data was then examined to etermine trends, consistantly and impacts f events such as gasoline non-availability n comparison to the first year data.

reatment of Data

Separate hourly totals of recreational raffic were combined and the four-hour tudy totals of vehicles were used for most nalyses. Analyses included: 1) Seasonal ariations in volume of recreational traffic nd types of equipment tallied, 2) Comparisons f volume and types of northbound versus outhbound recreational traffic, 3) Correlation etween patterns of travel revealed by collectd data and by other travel indicators, such s Amtrak passenger counts, total traffic olume (as determined by the Minnesota epartment of Transportation) and visitor-use ata of the Thompson Hill Information Center;) Relationships between recreational travel atterns and factors which possibly influence ravel such as holidays, special events, unting and fishing season openings, weather onditions and gasoline price and availability.

For brevity sake, only four factors hich were identified to exert significant nfluence upon recreational traffic will be iscussed here: 1) weather, 2) holidays-pecial events, 3) gasoline price and 4) asoline availability. A more detailed report n the second year data is in preparation.

eather Conditions

Weather conditions during 1978-79 were enerally similar to those during 1977-78. n both years, the beginning of November was arked by a rapid decrease in temperature, arly December was marked by a warm spike, nd the spring climb in temperatures was onger and more gradual than the fall decrease. emperatures started increasing in early arch and climbed steadily until early June efore leveling off. Major differences beween the two years were as follows: 1) here was more snow during 1978-79 than 1977-78. now depth climbed steadily to a peak of 30 nches in late February and early March. uring 1977-78, maximum average accumulation as only 12 inches by the end of February.) 1978-79 was a windier year than 1977-78, articularly during the fall and winter months.) Road conditions were more often poor during 1978-79 than during 1977-78, especially during winter. 4) The winter of 1978-79 was colder than that of 1977-78. Temperatures dropped below 32°F two weeks earlier than 1977-78 and did not reach above 32°F again until one week later. Also, there was no January thaw as there had been in 1977-78. 5) The spring was colder and later than in 1977-78. Average temperature stayed below 40°F until mid-May when it suddenly jumped to 50°. In 1977-78, average temperatures had reached 50° by late April and stayed above that temperature from then on.

Holidays and Special Events

Holidays were, of course, the same from one year to the next, as were the openings of hunting and fishing seasons. Types of special events, however, differed somewhat during the two years. Also, they did not always fall at the same time. In some cases a holiday and special event occurred on the same weekend during one year but on different weekends during the other year. This allowed separation of the effects which those two factors had on recreational travel.

Gasoline Prices

During 1977-78, gasoline prices in both Duluth and Minneapolis averaged \$.58 to \$.62 per gallon. They varied by no more than \$.08 per gallon throughout the year. They showed neither a net increase or decrease, but ended the year at approximately the same price as they started the year.

1978-79 was quite a different story. Prices rose approximately \$.05/gallon in the first six months of the study-year. During the second six-month period, they jumped another \$.28/gallon. This represented a 50% increase in prices between July 1978 and July 1979. Between August and December, Duluth gasoline prices were roughly \$.04/gallon higher than Minneapolis prices, as they had been through 1977-78. However, during the period of rapid price increase in the winter and spring, Minneapolis and Duluth prices were similar. By June and July, Duluth gasoline averaged \$.02/gallon less than Minneapolis gasoline.

Gasoline Availability

No shortages of gasoline availability occurred or threatened to occur during 1977-78 or during the first 9 months of 1978-79. However, by May 1979, the Minnesota Energy Agency began issuing warnings of upcoming shortage and voluntary cutback in gasoline consumption was urged. During June, gasoline shortages became more and more common until the end of the month, when they were fairly severe in some places. During

July, gasoline supply stabilized somewhat and by the end of the month, threats of more shortages were not so severe.

With these considerations in mind, it is now possible to compare the two years of recreational travel monitoring, with an eye toward identifying causes of differences between the two years.

Patterns of Traffic Flow

Seasonal changes in volume and composition of recreational traffic seen in 1978-79 were very similar to those seen in 1977-78. Bimodal distribution of traffic volume was observed during both years. Fall periods of very low recreational flow began and ended one to two weeks earlier in 1978-79 than in 1977-78, possibly due to the somewhat earlier drop in fall temperatures.

Spring periods of very low flow occurred during the same weeks in the two years. Beginning and end of the cold season, as defined by types of recreational vehicles counted, differed by no more than a week between the two years of observation. The appearance of cold season recreational equipment corresponded closely with the first appearance of snow, which was similar in the two years, rather than with other weather conditions, which varied a little between the two years.

Response to holidays and special events, as indicated by recreational traffic counts, was extremely consistent between the two years. All major holidays brought about the same response in recreational traffic. Special events varied from year to year, but three main events, the Duluth Annual Folk Festival, Fall Foliage Peak and University of Minnesota-Duluth graduation occur yearly. In both years of the study, the weekends of these three events showed large increases in recreational traffic in the north direction. All but the fall foliage peak also brought about a large increase in southbound traffic. During 1978-79, the combined effects of fall foliage peak and the opening of small game hunting may be linked with a decrease in southbound traffic, regardless of the large increase in northbound traffic.

During both years, there was a noticeable trend for special events within the city of Duluth to correspond with slight decreases in southbound traffic, i.e. recreational traffic leaving Duluth. Some examples are Park Point Art Fair, major UMD hockey games during 1977-78, Duluth Days - all-city celebration in 1977-78, Duluth city ski-jumping contest in 1978-79, and the city softball tournament in 1978-79. Essentially these events kept Duluth residents home and off the highway to other places.

Finally, response of recreational traf volume to hunting season opening weekends w quite similar in the two years. Opening of deer season consistently caused large increa in recreational traffic in both the north a south directions. Opening of small game season corresponded with very low levels of recreational traffic. However, opening week ends of steelhead fishing, smelting and oth fishing showed only slight increases in traffic in 1978-79, while in 1977-78, smelt and inland fishing opening weekends were accompanied by large increases. There are a least two possible explanations for this. Since the spring of 1978-79 was much colder and slower in coming to northern Minnesota than the previous spring, the beginning of fishing season was not as desirable a time t be outdoors for many people. Also, inland lakes were frozen much later. The smelt run was slower and more spread out than the previous year, therefore smelting activity woul not be likely to bring about as sharp an increase in traffic as the previous year. 2) The price of gasoline was increasing at the sharpest rate during this period of April, May and June of 1978-79. This may have discouraged people from traveling as far as th normally would have for fishing, especially when considered in combination with the col and wet spring that northern Minnesota was experiencing.

Volume and Composition of Recreational Traffi

Although seasonal trends in relative numbers of vehicles were similar in 1977-78 and 1978-79, there were significant differences in the absolute numbers of recreationa vehicles at any given time. During August, September, October and November, recreationa traffic volume in the second year was equal or somewhat lower than the first year. Between December and March, both north and sou bound traffic were significantly higher tha in the previous year. In April, southbound traffic was much higher, but northbound traffic was 33% lower than in 1977-78. From May on, both north and southbound recreation traffic were lower in the second year than i the first year.

Most likely, the large increase in cold season recreation can be directly related to the continuous and deep snow cover present i 1978-79. Amtrak records of skis carried dur ing the same time period showed an increase greater than 200% over 1977-78, which is probably indicative of the same thing. Cold and wet spring weather may account for the increase in southbound traffic and the decrease in northbound traffic during April an perhaps early May. However, by late May, temperatures were once again seasonable and her cleared up. It seems likely that the decreases in recreational traffic during , June and July may have been due to changes he price and availability.

A closer look at May, June and July data ds evidence to this suggestion. Table 1 sents the changes which occurred in recre- nal traffic between 1977-78 and 1978-79 a weekly basis. It is apparent that early and late June of the second year experi- ed the greatest reductions in recreational ffic of 20 to 55% from the previous year. entioned previously, low levels in early may have been due to the unseasonable cold eratures. However, neither temperature other weather factors explain the contin- low levels of recreational activity after -May. From mid-May to mid-June, recreation- ravel volume recovered somewhat, however, emained depressed approximately 10% rela- to 1977-78.

E 1: Weekly changes in recreational traffic volume between 1977-78 and 1978-79; May, June, and July

		Total Recreational Traffic 1977-78		Total Recreational Traffic 1978-79		% Change from 1977-78 to 1978-79	
May	1	158		73		-54	%
	2	185		145		-22	
	3	156		148		- 8	
	4	306		274		-10	
June	1	143		168		+17	
	2	285		250		-11	
	3	247		243		- 2	
	4	247		203		-38	
	5	562	813	256	593	-54	-27
July	1	251		337		+34	
	2	362		273		-25	
	3	282		200		-29	
	4	305		275		-10	
Total		3484		2845		-18	%

In late June and the first three weeks July, volume once again fell to levels 50% below those of the previous year. One eption was the first weekend of July, when ume was up by 23%. This is misleading, ever since the first July weekend was the of July holiday weekend in 1978-79, while 1977-78 the last week of June had been the holiday weekend. The best way to com- e this period and eliminate the holiday s was to lump the two weekend totals. lumped, overall net change for the two- k holiday period once again showed a sub- ntial reduction of 27% in recreational ffic volume. During the last week of July, traffic volume returned to only 10% below 1977-78 levels.

The factor which seems most likely responsible for the general decrease in recreational traffic between the spring of 1977-78 and the spring of 1978-79 is the high escalation rate of the price of gasoline which occurred during spring of 1978-79. By itself, this factor seemed to account for a decrease of roughly 10%. Other factors in combination with high gasoline prices were capable of further reducing recreational travel to levels 20-50% below 1977-78. These other factors were the unseasonable cold weather in early May and the gasoline shortages in late June and early July. Once gasoline shortages were somewhat ameliorated in late July, travel seemed to have increased back to 10% below 1977-78 levels.

The observed spring decrease in travel was more marked in the northbound direction than the southbound. Average percent change for May through July was -23% for northbound traffic but only -13% for southbound. In 1977-78, northbound traffic between January and July averaged 70% higher than southbound. In 1978-79, it averaged only 8% higher, before January, northbound traffic exceeded southbound by a similar amount of less than 20% in both years. January was the month during which gasoline prices first started to increase after sixteen months of stability. This differential directional effect may have been due to the fact that areas south of Duluth were hit harder by both gasoline price increases and shortages than was the Duluth area. A check with local stations verified this as supplies were available during the entire period.

In addition to the depressive effect which high gasoline prices and low availability had on travel volume, they may have been responsible for changes seen in the mode of travel which people used. Table 2 shows the

TABLE 2: Distribution of carrier types in 1977-78 and 1978-79

Carrier type	1977 - 78		1978 - 79	
SEDAN	45	%	38	%
PICKUP	28		41	
FOUR WHEEL DRIVE	6		6	
MOTORHOME	15		10	
MOTORCYCLE	3		3	
CONVERTED BUS	1		1	
CHARTER BUS	1		1	
OTHER	1		0	
TOTAL	100	%	100	%

relative abundances of different vehicle types during the two years. Motorhomes and sedans showed significant decreases in relative abundance between 1977-78 and 1978-79 while pickups increased. Change in absolute numbers of different types of vehicles are shown in Table 3. Between the first and the second year, motorhomes decreased by 44%, sedans by 29%, 4-wheel drive vehicles by 18%, and other vehicles by 30%. Pickup numbers increased by 23%, despite an overall decrease of 16% in total recreational travel.

TABLE 3: Change in numbers of recreational vehicles from 1977-78 to 1978-79

Type of Carrier	1977-78	1978-79	% Change
Sedans	4063	2871	-29 %
Pickups	2528	3098	+23
4-Wheel Drive	542	453	-18
Motorhome	1354	756	-44
Other	542	378	-30
Total	9029	7556	-16

A drop in the number of motorhomes is understandable in light of gasoline price changes. Motorhomes are typically much less gasoline efficient than other types of vehicles. The shift from sedans to pickups is less understandable. However, gas mileage of large sedans and pickups are comparable. Possibly the shift represents a movement away from vehicles with fairly limited usage to those which are more versatile in their use and utility.

REFERENCES

Blank, Uel, in preparation. Duluth-Superior's Travel/Tourism Economy. University of Minnesota, Agricultural Extension Service, St. Paul, Minnesota.

Norton, A.J., Hales and T. Wood. 1978. Recreational Traffic, Thompson Hill, Technical Report No. 1. Lake Superior Basin Studies Center, University of Minnesota, Duluth.

Wolfe, R.I. 1969. A tentative procedure for estimating recreational highway traffic. Traffic Quarterly, Volume 23, No. 1, pp. 163-177.

____________. 1977. Predicting recreational highway Traffic in Canada at a time of scarcity and high cost of motor fuel. Paper presented at joint meeting of The International Geographical Union and Geography section of the British Association, Birmingham, England. September 3-4, 1977.

SNOWMOBILING IN THE 1980'S:

CONTINUED PROGRESS FOR A MATURE RECREATIONAL ACTIVITY[1]

William T. Jobe, Jr., President
International Snowmobile Industry Association
1800 M Street, Northwest, Suite 850 South
Washington, D. C.

In less than two decades, snowmobiling has changed from a novelty to a way of life for some 20,000,000 Canadian and American citizens of all ages. Why has snowmobiling continued to mushroom? Why did the challenges of inadequate safe use areas, public criticism and skepticism and primitive machines fail to doom the activity to a passing fad?

The answer is two-fold. First, through snowmobiling the unique grandeur of winter outdoors is unlocked for North Americans of all ages and of all levels of physical ability.

The second reason for the success of snowmobiling is "power through partnership". A unique array of imaginative and active individuals in government and industry, concerned enthusiasts and tourism officials together have made snowmobiling an integral part of the lifestyle of North American families.

In spite of poor snow in many areas, this past season has been a time of excitement for those connected with snowmobiling. New friends and supporters of the industry and sport appeared in high government posts, in the major media and in the tourism/leisure sector. This new positive face of snowmobiling stands in stark contrast to the image of the sport in the early 1970's.

A good part of this new image is the direct result of the snowmobile community's ongoing commitment to confronting and dispelling myths connected with the activity and speaking out publicly about snowmobiling and the people who enjoy it. The snowmobile story is being told at public hearings, on radio and television talk shows, in tourism campaigns, in newspaper and magazine articles, through letters to the editor and in face-to-face communications with elected and career government officials.

Today's new and quiet snowmobiles make complaints rare except for instances of operator misuse. As a result, snowmobile sound level concerns are yesterday's problem.

INDUSTRY SALES

The 1978-1979 winter was a notable successful selling season for the snowmobile industry, as retail sales of new snowmobiles climbed to 267,000 units, 18% above the level of the previous year. Key contributing factors included: a new mood of optimism among dealers following the successful 1977-1978 selling season (which saw a 16% sales increase over the winter of 1976-77), an exciting lineup of new snowmobiles in all price categories; good snow conditions in most areas of North America; steady improvements in snowmobile use opportunities; and new positive media treatment. The sales increase was most vigorous in the United States, which saw a 24% jump.

Unfortunately, our sales report for the selling season just concluded is not quite so rosy. Because of a record absence of snow in our prime marketing areas, our sales are below last year. I know this phenomenon of poor snow conditions is one our skiing friends would also like to see disappear forever. The long-term prognosis for snowmobiling is excellent, however.

As we look to a new decade of snowmobiling activity, the snowmobile industry expects that we will see outstanding opportunities. Demographic information and analysis of societal trends lead us to conclude that exciting, novel, flexible and outdoor recreational activities will experience continued growth in the 1980's. Latent interest in the sport participation in snowmobiling is likely to increase substantially over the next five years.

In fact, study after study demonstrates that snowmobiling activity has increased sharply. At the same time, the sport is experiencing a curious decline in visibility in populated snowbelt regions. This reduced visibility of snowmobiles is not the result of decreased activity; rather, it is a consequence of a new trail networks which take snowmobilers to the scenic natural areas they seek and away from populated areas with potential environmental and social conflicts.

---

[1] Paper presented at the National Outdoor Recreation Trends Symposium, Durham, NH, April 20-23, 1980.

SNOWMOBILE TOURISM GROWS

Progress in expanding snowmobile tourism opportunities continues at a fast clip. A fine example of the new prevailing attitude towards winter tourism is found in the theme selected by Minnesota for its promotional campaign last season:

"If God meant for people to vacation in warm climates, why did He make winter in Minnesota so much fun?"

New promotional campaigns featuring snowmobiling are now being mounted in a large number of jurisdictions including Michigan, Manitoba, South Dakota, Minnesota, Pennsylvania, and by the Canadian Government Office of Tourism. The latter's campaign included full color advertisements placed in major North American magazines lengthy, well-written articles which have been picked up across the U.S. and Canada. One of the articles began:

"Canada is a snowmobiler's paradise. From coast to snowy coast, thousands of Canadians and winter visitors are hitting the trails, making this one of Canada's fastest growing sports."

THE FUTURE OF SNOWMOBILING

Two factors central to the long-term health of the snowmobile industry and sport are access to trails and other use areas; and availability of energy.

Land and Trails

If participation in snowmobiling is to increase in the 1980's at a continuing fast rate, all segments of the snowmobile community must continue to coordinate their efforts to expand opportunities for safe and fun outdoor winter activity. The snowmobile community has a stake in countless public land use planning activities as well as federal legislation on such issues as Wilderness. In the latter case, the snowmobile community finds itself, along with a myriad of other recreational groups, sorely neglected. Its interests lie neither with vocal commodity producers nor vocal preservationist interests, yet those two antagonists receive the preponderance of attention from elected officials.

Providing land areas for snowmobiling is but the first step in meeting current and future snowmobiler needs. Just as important is the need to maintain and expand government programs to fund the construction and grooming of snowmobile trails and the construction and maintenance of parking areas, warming shelters, and other facilities that are essential to safe enjoyment of snowmobiling and the growth of the sport.

Acceptance of the desirability of snowmobile trails and responsibility for their creation and maintenance is now evident throughout government agencies in snowbelt North America. Slowly but surely, the traditional view that outdoor recreation ends with the coming of snow is being displaced by a sense that winter offers the opportunity to enjoy unique fun and beauty outdoors. This changed perspective will be extremely helpful over the next decade, and should boost the current total of 90,000 miles of marked and maintained public trails for snowmobilers across North America.

Without appropriate levels of funding, adequate, safe and enjoyable trails cannot exist. Without suitable funding, snowmobile program enforcement and youthful operator training programs cannot aid in assuring that the sport is safe for North American family members of all ages.

To support trail development and maintenance, the snowmobile community has been active in promoting the benefits of a good trails program paid for with snowmobiling-generated revenues. Organized snowmobilers have criticized governments for failing to protect the safety of citizens where there are insufficient safe, well maintained trails and applauded governments that build and groom safe use areas and trails. Tourism professionals with an interest in winter have added a "commercial interest" voice, urging trails and facilities to support their quest for winter tourist dollars. These efforts have worked exceedingly well in expanding spending for snowmobile trails during the past decade.

Yet tight government budgets in the coming decade will pose a challenge to all recreational activities, including snowmobiling. "Earmarking" of funds -- especially snowmobile registration fees and gasoline taxes on snowmobile fuel -- will prove more difficult in the days ahead. Annual campaigns to maintain and boost snowmobile trail program budgets will be increasingly important in the 1980's.

One important factor greatly aiding the

expansion of snowmobile trails is the snowmobile itself. Today's snowmobiles are remarkably quiet -- operating at a level 94% below their counterparts of ten years before. New snowmobiles are certified independently as emitting no more than 78 dBA under a full-throttle acceleration test and no more than 73 dBA at a constant speed of 15 mph. But even those figures are deceptive. U.S. Forest Service researcher Robin Harrison, a mechanical engineer, reported recently:

"Snowmobiles almost always emit less noise under actual operating conditions than under certification conditions...even trying as hard as we could...we could not make any of the snowmobiles come up to 78 dB(A).

"...The results I have described, along with...other data, are incorporated in the noise pollution prediction method developed by the Forest Service...(U)nder the absolute stillest, most quiet background conditions that I have ever recorded, the method estimates that these new snowmobiles would be barely audible, to a very carefully listening listener, only a very small percentage of the time, at 3000 feet...Bear in mind that the ambient sound level I am describing is less than 20 dB(A)--an extremely unusual situation. Under the more usual conditions found in a wildland or outdoor recreation situation, with the ambient reading in the 30 dB(A) range, snowmobiles would probably not be detected beyond one-fourth of that distance...(U)nder conditions of a developed winter campground, which included some typical campground sounds ...at distances beyond 400 feet, the snowmobile was only barely detectable above the normal campground noise."

Improvements in the machine go beyond sound levels. Today's snowmobiles are dependable, easy to operate and safe for family members of all ages. Virtually every major safety-related component meets a rigid voluntary standard. Moreover, an independent testing company provides the public with certification that these standards are met. Every snowmobile being produced for sale in North America is currently covered by this program.

Gasoline Availability

Also critical to the future of the sport of snowmobiling is the continued availability of gasoline to power the machines. Since 1973, the snowmobile community has fought for -- and succeeded to date in securing -- equitable treatment of snowmobiling in energy policy decisions.

Beginning with the Arab oil embargo in 1973, the need for snowmobile community vigilance on energy issues has been made clear repeatedly. The U.S. House of Representatives considered a 20% excise tax on snowmobiles, boats and private aircraft in 1975 and rejected it. During the winter of 1978, the U.S. Congress comtemplated imposing mandatory energy conservation measures on various vehicles used for recreation and chose not to do so. During 1979, the U.S. Congress considered and defeated a discriminatory gas rationing plan.

The next several years may bring similar misguided energy-related challenges to snowmobiling. In both Canada and the U.S., pressure will be exerted by the federal governments to force conservation of energy, especially gasoline. Pricing policies, allocation systems and perhaps even rationing programs will be utilized.

We feel quite confident that any proposals narrowly targeted at snowmobiling or other motorized recreation activities will be ultimately rejected both on grounds of fairness and on the political ramifications from a strong and unified snowmobiler community. Our belief is based upon the minuscule amount of gasoline used by each snowmobiler, and by all snowmobiles collectively.

The average snowmobile uses some .89 gallon per hour. The sport, collectively, consumes 12/100ths of 1% of all gasoline used in the United States. These consumption figures, based upon federal contractors' work, have been widely acknowledged. The Council on Environmental Quality published the report "Off Road Vehicles on Public Land" in May 1979. That report concluded:

"ORV and snowmobile use represents such a small fraction of the nation's energy consumption that even if they were entirely eliminated, the energy saved would probably not be worth the effort."

That conclusion was further reinforced on the floor of the U.S. Senate by fifteen Senators in a colloquy on snowmobiling last July. These Senators, Democrats and Republicans, from the east and from the west and representing all points on the ideological specturm, pledged their efforts to assure fairness in federal policies affecting snowmobiling and to assure the availability of gasoline and the scenic natural areas on which the sport depends. A few quotes follow:

from the Honorable Max Baucus, U.S. Senator from Montana --

"When we start creating priorities among various users of energy, we run the risk of making serious mistakes...I simply pose the question of what kind of a society would we have if we allowed no energy use for recreation? Either indoor or outdoor? I believe that recreation -- leisure time activity -- is very important to our form of society, to our mental and physical health. Therefore, when we plan for energy uses, I urge ample and due consideration to be given to the use of energy in recreation."

from the Honorable Jake Garn, U.S. Senator from Utah --

"Whether it is the energy to allow a worker to get to his job, or to allow a Pennsylvania family to travel to the West by automobile to see our national parks, or the energy needed by snowmobilers to overcome the barriers of freezing temperatures and deep snow, we need to take the steps now which will assure its availability."

from the Honorable Donald Riegle, Jr., U.S. Senator from Michigan --

"Snowmobiles use very little gasoline, accounting for barely 12/100 of 1 percent of our national comsumption. I don't think that anyone in the recreation industry would quarrel with the need to conserve fuel, and to restrict use during severe supply shortages, such as those that would trigger rationing. My point is that any rationing plan must be constructed in an equitable manner, so that all forms of travel are impacted in an equal fashion."

SUMMARY

Compared to its first two decades, snowmobiling's third decade should prove clearly positive and less volatile. As snowmobile trail networks continue to grow so, too, will the network of resorts and support facilities serving the snowmobiling public. Happily, evidence today suggests that actions by government, by snowmobiler associations, by governmental and private tourism organizations and by the snowmobile industry are well underway to continue to make snowmobiling a popular element of the North American winter recreational scene.

Moreover, by working with the nordic ski community, government officials at various levels, tourism interests and others, the snowmobile community believes it can hlep make winter outdoors more fun for Americans of all ages -- offering a safe, exciting and healthful alternative to sedentary, indoor winter lifestyles.

WOODALL PUBLISHING COMPANY, AN IMPORTANT INDUSTRY SOURCE OF CAMPING INFORMATION[1]

Curtis Fuller, Chairman of the Board
Woodall Publishing Company
Highland Park, IL

Paul Foght, Marketing Director
Woodall Publishing Company
Highland Park, IL

Linda Profaizer, Directory Publisher
Woodall Publishing Company
Highland Park, IL

Since 1967 the Woodall Publishing Company of Highland Park, Ill., has gathered annual statistics on privately owned campgrounds in the United States, Canada and Mexico and to a lesser extent on public campgrounds. At first the information gathered consisted of little more than hand tallies of the number of campgrounds by state and degree of development, of the number of campsites in the campgrounds and a breakdown of those campsites by number of electrical, water and sewer hookups available. It has since become much more detailed.

This information is gathered by on-site nnual inspections of the privately owned ampgrounds, by occasional inspection of ublic campgrounds and by annual mail questionaires to all known public campgrounds. The nspectors are husband-wife teams who visit he privately owned campgrounds personally, ate the campgrounds and complete detailed escriptive listing forms.

The information thus gathered is placed n an editorial format and printed in the arious editions of Woodall's campground directories. Woodall's began with 15 husband-wife ield teams and today has 30 to 40 such teams. ey are individually trained in the field d in week-long annual seminars.

Each year Woodall's inspects and rates 000 to 11,000 private campgrounds, inspects ome publics, and gathers mail data on 4,500 6,000 more publics. Because the data is by-product of the production of Woodall's mpground directories every effort is made to keep it as accurate and as reflective of trends as possible. Occasionally Woodall's receives criticism that the information is limited to the campgrounds listed. Woodall's response is that no other institution makes annual inspections of all campgrounds, even within a state. Obviously no such collection of data can be perfect, but it is believed to be the best possible to obtain from a practical viewpoint. It would be impossible to duplicate by mail surveys.

The Woodall data does not cover every U.S. private campground. It does not include those with fewer than 10 spaces but it does include mobile home parks which reserve five or more spaces for transients. It does not include campgrounds where Woodall representatives subjectively would not care to stay. It does not include campgrounds with filthy washrooms or dirty and littered campsites and grounds. Each year Woodall's deletes 500 to 1,000 campgrounds for various reasons.

When one considers Woodall's data -- or any data on campgrounds -- the first problem is one of definition. What is a campground? That is a difficult question and Woodall's has been wrestling with it for many years. Is it a lovely spot beside a lake or a river with a few designated sites and only a pump for water and outhouses for relief? Woodall's definitions state simply "yes, it can be," depending on the representative's report. Is it a paved RV park parking lot? Is it a lots-for-sale condominium resort? Is it a park filled with season leases? Is it a time-sharing resort? There are many questions and Woodall's currently defines a campground in rather general terms as follows:

"A campground is a camping area, usually in a rural or natural setting, that accepts both tents and recreational vehicles. There may be little formal development."

---

[1] Paper presented at the National Outdoor creation Trends Symposium, Durham, NH, April -23, 1980.

"An RV park is a camping area that usually has devoted considerable attention to formal site development. It generally caters to RV's and their requirements. Often an RV park does not accept walk-ins or tents and sometimes does not accept tent trailers or other non-full hookup units."

From the first simple hand tallies of data beginning in 1967 Woodall's information has progressively become more detailed until today complete computer print-outs of information are available by state and nationally for the following information:

1. Comparative totals of private and public campgrounds by year, giving facility ratings and number of total campsites, and with tallies of electric, water and sewer hookups, number of campgrounds planned, and number under construction. This data has been gathered since 1967.

2. Since 1977 Woodall's has produced an annual computer count of total facilities in 113 categories by state and nationally in all private campgrounds. The data has not been collected long enough to provide meaningful trends.

3. Intermittently through the years, and most recently in 1977, 1978 and 1979, the base rates charged by private campgrounds have been compiled by state and nationally. This study has become progressively more complete through the years.

In addition to these ongoing studies, the company has from time to time hired private research firms to conduct studies of the RV industry and of campers both to provide marketing information and guidance for editorial policies. The company division that has sponsored these surveys is Woodall's Trailer & RV Travel, a leading RV camping magazine.

The history of market research at Woodall's encompasses five major studies conducted in 1969, 1973, 1978 and 1979. All of these studies were conducted for Woodall's by recognized market research firms using self-administered direct mail questionnaires, pretested by interviews, and mailed to randomly selected owners of recreation vehicles.

These efforts were preceded by a series of interviews with recreation vehicle campers in five states conducted in 1967 for Woodall's by Dr. Bernard I. Loft of Indiana University.

Although Dr. Loft's sample was small, and his procedure for selecting interviewees highly personalized, that study reached conclusions about the RV camping family which, although contrary to the conventional wisdo of the time, have only been further substantiated by our decade of structured studies computed with lots of weighted sums and sta ard deviations.

The conclusions about RV campers that have stood the test of time and statistical inquiry are:

Observation #1. RV campers are relati ly affluent. In 1967, the individuals inte viewed had median incomes of approximately $9000 which compared to a median of $8330 i 1966 for male professional and technical workers.

In 1979, subscribers to Woodall's RV TRAVEL Magazine have average household inco of $24,700 with 43% earning over $25,000. this point it should be noted that in 1969 and 1973 Woodall's studies involved panels 6000 RV campers, 3000 selected from the sub scription list of WOODALL'S RV TRAVEL Magazine and 3000 controls selected from state RV license registration lists. Except for the magazine subscribers having upscale dem graphic characteristics, these groups appea ed so much alike that panels of 3000 magazi subscribers only were used for two 1978 studies and the 1979 study.

Observation #2. RV campers are mature In 1967, the median age of Dr. Loft's inter viewees was in the range 50 to 54. In 1979 WOODALL'S RV TRAVEL subscribers has a media age of 52.8, with 56% being between age 45 and 64.

Observation #3. Only half of RV campe travel with children. In 1967, the median number of persons camping in the groups int viewed by Dr. Loft was two. That number wa still correct in 1979, and the young age of children who do sometimes camp with the RV owner strongly suggests that they are grand children of the RV owners.

Besides determining that the demograph character of the RV camper has been unchang ing, Woodall's studies have been designed to predict purchasing intentions for RVs an RV accessories, and travel patterns. In th role, the studies have demonstrated a high prediction value. In 1969, the shift from towed to motorized RVs was foreseen. In 197 RV camper interest in smaller RVs was predicted. In 1979, our study also showed tha the number of days of camping would remain essentially unchanged, but that distance traveled would be shorter. An interest in owning condominium campsites was measured a the 10% level in 1979, but it was also foun that owners of such campsites still tend to take a major vacation trip away from that proprietary location.

Still uncorroborated by other work is our 1979 effort to establish the lifestyle characteristics, or psychographics, of the RV owner. We found the RV camper to be more family oriented than average, and we found the family unit gets along better on camping trips -- both parent to child and husband to wife. We found RV campers to be outgoing people who like to come and go as they please. Many are seeking release from stressful occupations and seek an opportunity to do nothing. The RV camper was found to be practical minded and careful of how money is spent. This manifests itself in a consumer who is price sensitive, but not as the result of low income. Through choice, RV campers regard themselves as do-it-yourselfers. This trait is probably a manifestation of an independent lifestyle and a desire to be creative.

Because Woodall's demographic observations have been corroborated by the very significant consumer attitude studies being sponsored by the Recreation Vehicle Industry Association at the University of Michigan, we look forward to the time when they will also confirm our findings on these lifestyle characteristics.

Other obvious industry sources which have made important camping studies are A.C. Nielsen Company, the Gallup organization, Minnesota Mining & Manufacturing Company, and the Recreational Vehicle Industries Association. The latter organization publishes monthly reports of RV shipments by manufacturers in various categories and is reported to be planning to develop a reporting system for RV sales at a dealer level.

The consumer studies RVIA is currently funding through the University of Michigan may prove even more valuable than these efforts. In defining the characteristics of the RV owner, these studies have demonstrated that the RV family is most likely to be one that owns three or more motor vehicles. In examining the intentions of non-RV owning families to buy RVs, the study currently finds that the intention to buy is low, but the intention to rent an RV is very high, suggesting that there are still additional families planning to join the RV camping community.

All of Woodall's current data points to a reasonably healthy private campground industry at present, as contrasted with the state of RV manufacturing, which at this time is operating at less than half of 1978 volumes. Exhibit I charts a fairly constant gain in private campgrounds between 1967 and 1973 when the country began to experience fuel difficulties. There was a slacking off in number of campsites added to the national inventory until 1976 when there was a rather dramatic rise through 1979.

Within this overall picture, the number of campgrounds that Woodall's believed worth inspecting and listing dropped overall from 9,591 to 8,016 (Table 1). The number of private campgrounds has varied by no more than 200 from a mean of 8,000 for the years 1975 through 1979. During the same five years, however, the number of campsites has continued to increase.

When Woodall's began its record-keeping for the 1967 calendar year, 267,424 campsites were found in private campgrounds. This was an average of only 27.88 sites per campground. That figure increased annually for the next 13 years and in 1979 averaged 96.57 campsites per campground. Since several studies have shown that only larger campgrounds can generally hope to be profitable, this trend can be expected to continue.

During this same 13-year period the number of full hookups in private campgrounds increased from 98,000 to 332,000, while the proportion of such hookups increased from 26.4% to 42.9%. The proportion of hookups with water and electricity also increased while the number of campsites without any hookups declined from 143,000 in 1968 to 107,241 in 1979. Percentagewise, 38.3% of private campsites had no hookups in 1968 while only 14.0% had no hookups in 1979.

The record clearly shows a dramatic increase in campground amenities, expansion and investment and a falling out of marginal campgrounds during the years studied.

The same trends can be shown for public campgrounds although the statistical record is more uneven. This unevenness may reflect Woodall's inability in all years to obtain equal responses from its mail questionnaires to the public campgrounds. Nonetheless, over the 13-year period in question, the total public campground inventory does not seem to have changed appreciably but the number of campsites has nearly doubled, from 177,000 to 339,374 (Table 2). During the same period the size of the average public campground increased from 30.99 campsites to 67.12 campsites.

The public campgrounds remain substantially less developed than the privates (Exhibit 2). In 1979 only 3.28% had full hookups compared with 42.9% for the private campgrounds; only 11.9% had water and elec-

EXHIBIT I. Changes in Inventory of U.S. Private Campgrounds, 1967-1979

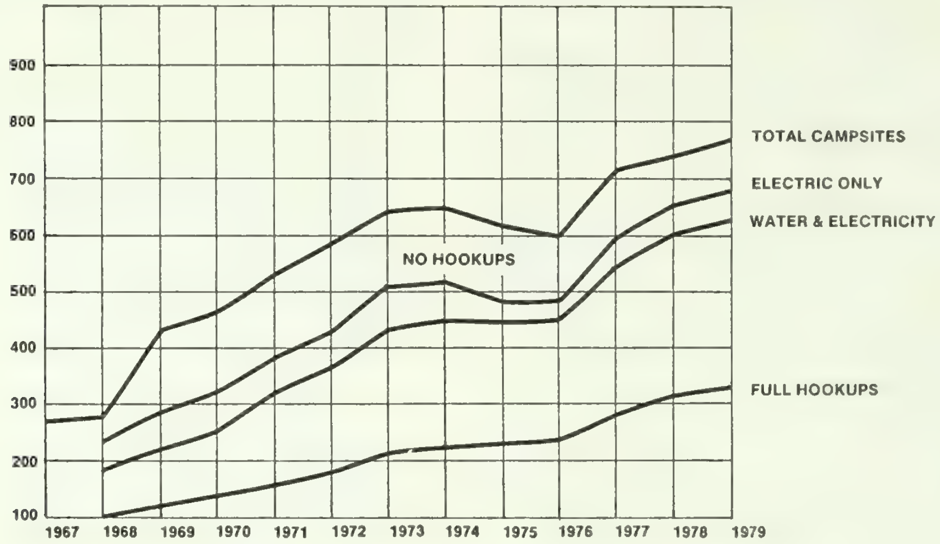


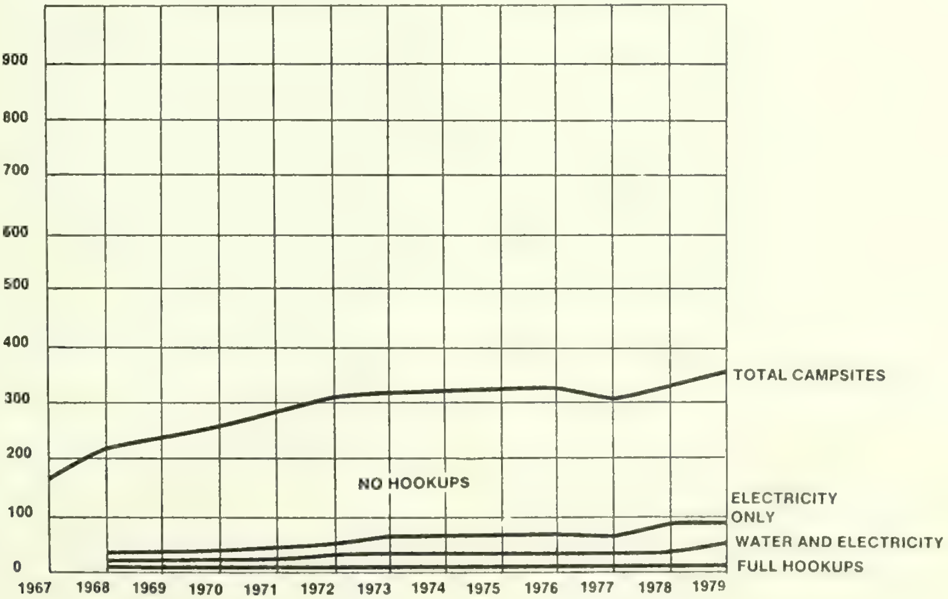
TABLE I. U.S. Private Campgrounds by Year 1967-79

YEAR	NUMBER OF CAMPSITES					NUMBER OF CAMPGROUNDS	AVERAGE NO. OF SITES PER CAMPGROUND
	Full Hookups	Water & Electricity	Electricity	No Hookups	Total Campsites		
1967					267,424	9,591	27.82
1968	98.410	177.713	229,904	142,984	372,888	9,520	39.17
1969	116,996	215,349	286,785	138,831	425,616	9,267	45.93
1970	127,297	250,951	318,707	143,679	462,386	9,513	48.61
1971	152,357	312,906	385,337	148,747	534,084	8,665	61.64
1972	178,429	358,658	429,299	154,380	583,679	9,190	63.51
1973	215,082	432,855	501,782	142,284	644,066	9,044	71.21
1974	227,195	454,152	512,900	130,253	643,153	8,685	74.05
1975	229,292	448,447	494,552	117,421	611,973	8,180	74.81
1976	232,941	449,211	492,261	107,707	599,968	7,864	76.29
1977	285,532	555,083	602,835	113,887	716,722	8,164	87.79
1978	313,995	601,263	649,084	103,770	752,854	8,202	91.79
1979	331,799	622,786	666,895	107,241	774,136	8,016	96.57

TABLE 2. U.S. Public Campgrounds by Year 1967-79

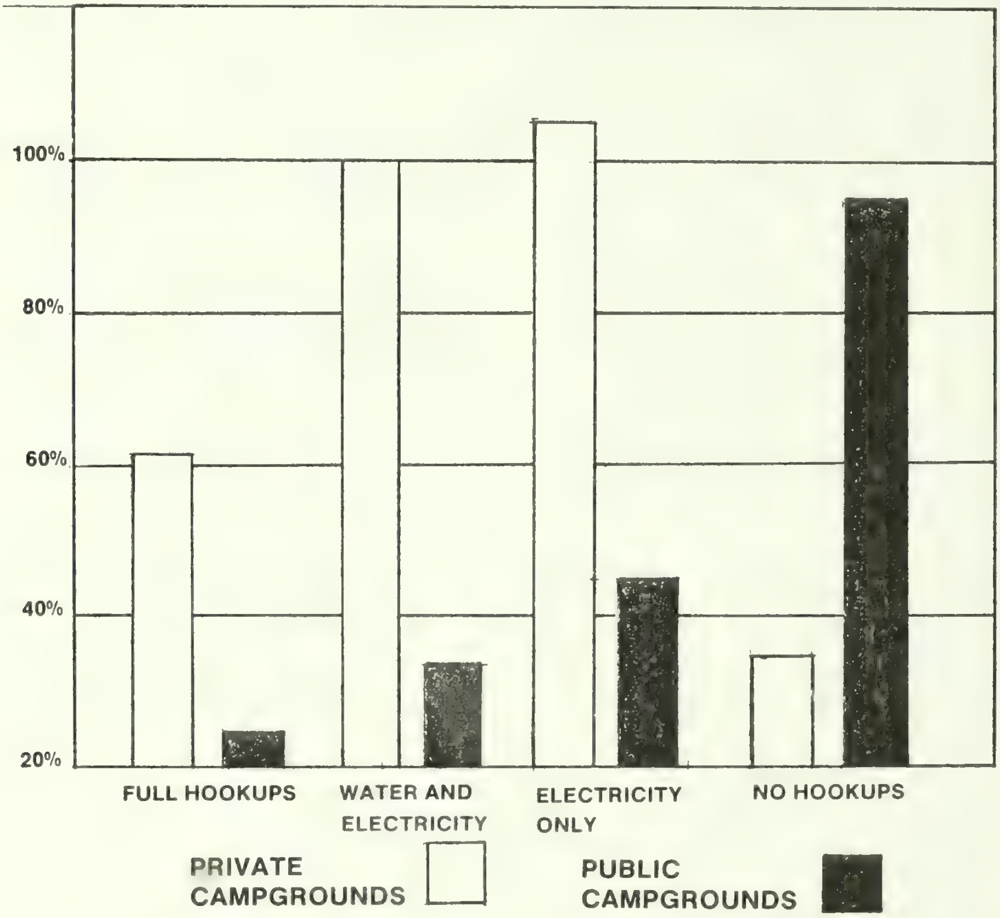
YEAR	NUMBER OF CAMPSITES					NUMBER OF CAMPGROUNDS	AVERAGE SITES PER CAMPGROUND
	Full Hookups	Water & Electricity	Electricity	No Hookups	Total Campsites		
1967					177,000	5,711	30.99
1968	4,607	10,257	32,004	173,450	205,454	6,626	31.00
1969	4,840	9,947	33,148	197,247	230,395	6,928	33.26
1970	4,720	10,269	33,402	214,070	247,472	7,566	32.71
1971	6,871	13,818	47,990	237,985	285,975	6,613	43.24
1972	7,943	24,008	58,821	247,238	306,059	6,463	47.36
1973	8,378	27,856	69,158	251,483	320,641	5,679	56.46
1974	8,642	29,490	74,570	247,103	321,673	5,439	59.14
1975	8,716	30,843	74,715	246,940	321,655	6,168	52.15
1976	9,158	33,564	77,973	254,924	332,897	5,792	57.48
1977	10,651	33,406	73,934	237,280	311,214	4,668	66.67
1978	10,308	38,097	84,142	244,877	329,019	4,991	65.92
1979	11,136	40,542	90,807	248,567	339,374	5,056	67.12

EXHIBIT 2. Changes in Inventory of U.S. Public Campgrounds, 1967-79



tricity, and only 26.8% had electricity. Since 73.2% of public campsites have no hookups of any kind it is obvious that they serve a somewhat different purpose or a different public than do the private campgrounds (Exhibit 3).

EXHIBIT 3. Comparison of Hookups in Private vs. Public Campgrounds, 1979



Woodall's has maintained records of the reasons for deleting campgrounds from its directory since 1969. During the 11-year period through 1979, the company deleted 10,129 private campgrounds from its directory listings--a remarkable indication of the volatility and turnover in this industry. It should be noted that the 10,129 figure is more than 2,000 higher than the toal number of U.S. privately owned campgrounds listed in the company's directory today. These deletions by year are shown in Table 3.

Of the 1095 deleted in 1979, 47.4% or 519 were deleted because they had fewer than 10 spaces or were considered to be substandard. Another 57% or 625 were either out of business or were no longer able to accept new campers because they were full of permanent campers. The balance, 176 or 16.1%, were deleted either at the owner's request or represented duplicate directory listings. It is estimated that about a third of the latter group or about 5% to 6% of this group were deleted at the owner's request.

TABLE 3.

Deletions From Woodall's Campground Director
(1969 through 1979)

1969	957
1970	805
1971	643
1972	767
1973	1,294
1974	1,348
1975	1,004
1976	848
1977	497
1978	871
1979	1,095

The company has not made a definitive analysis of the reasons for the 10,000 deletions over the years but such study would undoubtedly provide significant information

It has been apparent to most students of private campgrounds that it has not been a highly profitable industry. All studies made of the campground business have concluded that campground rates tend to be too low and that small campgrounds are unprofitable. For this reason Woodall's, as a publishing company serving all segments of the camping/RV industry, has taken the position that higher campground rates, by strengthening campgrounds, do at the same time strengthen all areas of the industry and make it more attractive to campers. Woodall's began to gather campground rate data in 1968 and has carried on interim studies from time to time, with annual studies being made since 1977.

To simplify its analysis of campground rates, the company adopted the system of recording base rates, even though the difinition of base rate differs from campground to campground. The variation in methods for calculating rates varies so widely among campgrounds that any other approach would be unwieldy.

In 1968, Woodall's studied the base rates of 3,614 campgrounds and discovered that 1,911, or more than half, were charging $2.00 or less as a daily fee; 1,159 were charging either $2.25 or $2.50; 439 were charging over $3.00. By 1977 the mean base rate charged by campgrounds had increased to $4.50 per night and in 1978 to $5.00. In 1979 it was between $5.00 and $5.50 with the average base rate, assuming a one-night stay in every U.S. campground, standing at $5.32. In 1979 38.7% of campgrounds had base rates of $6.00 or more and 3.9% charged $8.00 or more. The spread of 1979 rates is charted on Exhibit 4 and in the following Table 4.

In interpreting this data it should be remembered that there is no standard according to which base rates are charged. Some campgrounds have a basic charge for two persons, with extra charges for each additional person. Some do not charge for extra persons. Some have a basic charge for four. Some charge by the family. Others charge per person in the party. There are also varying extra charges for one, two or three hookups while some campgrounds include all hookups in their base charge. Woodall's has the data on these variations but has not attempted to analyze it except in general terms.

The third general area in which Woodall's directory division gathers data is to tabulate various facilities. These also are broken down by state and nationally. In 1979 Woodall's produced data on the recreational facilities of private campgrounds in 83 categories, including recreation halls, heated pools, river swimming, canoe rentals, boat ramps, golf courses, handball courts, horseriding trails, float trips, racquetball courts, snowmobiling trails and so on. Physical facilities in campgrounds were broken down into 48 categories. All this information is available but would be tedious to list here.

In summary, then, the Woodall Publishing Company has enormous amounts of digested, semi-digested and raw data on campgrounds which it is willing to make available to qualified industry sources and researchers. The computerized data in Woodall's files and in its campground directories represents the physical status of the private campground industry, and to a lesser extent of the public campground industry, on an annual basis.

Woodall's 1980 directories contain descriptions of 13,072 campgrounds and RV parks and nearly all of this information has been summarized in computer print-outs. In addition, similar data is available on 2,504 campgrounds and parks in Canada, Mexico, and Central America.

An additional 890 which were rejected in 1979 as not qualifying are in the file and the data for this is also available.

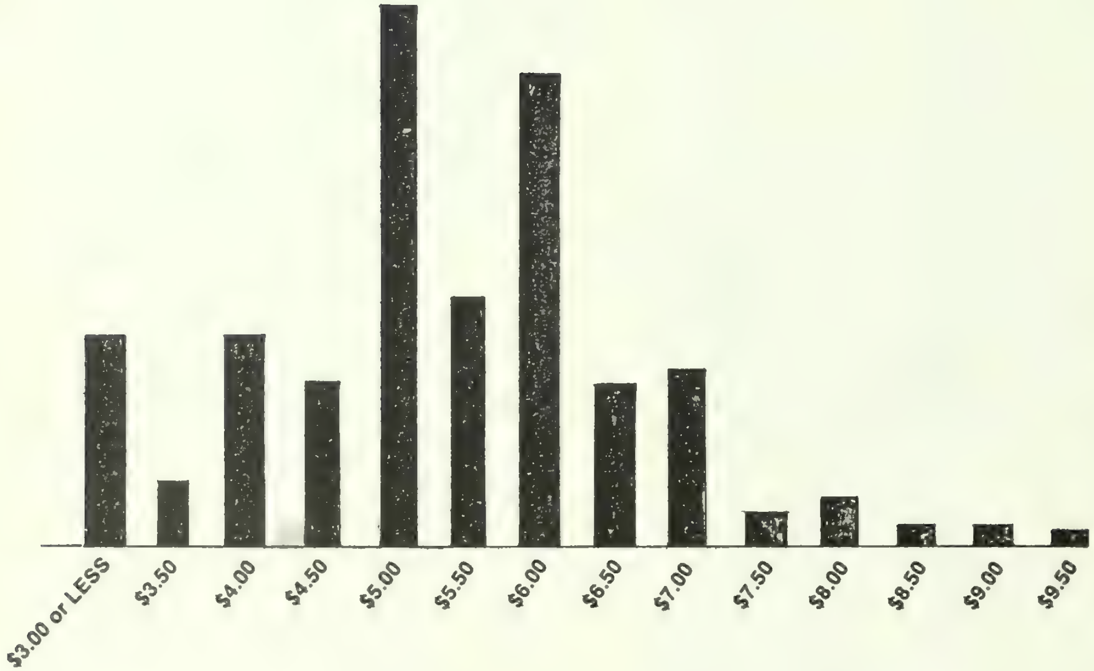
Table 4

BASE RATES CHARGED BY U.S. CAMPGROUNDS, 1979

Base Rates	Number of Campgrounds
$3.00 or less	711
3.50	205
4.00	740
4.50	655
5.00	1,787
5.50	815
6.00	1,526
6.50	531
7.00	573
7.50	163
8.00	178
8.50	63
9.00	54
9.50	18
Total Reporting	8,019

Average: $5.32

Exhibit 4. Base Rates Charged by 8,019 U.S. Campgrounds, 1979



NUMBER OF CAMPSITES IN ALL STATES - 1969 vs. 1979

State	No. of Campsites in Private Campgrounds 1969	1979	No. of Campsites in Public Campgrounds 1969	1979	Total Campsites 1969	1979
Alabama	3,533	3,901	643	3,222	4,176	7,123
Alaska	1,588	1,605	1,727	1,944	3,315	3,549
Arizona	11,325	33,354	3,383	6,217	14,708	39,571
Arkansas	1,585	4,576	4,550	5,221	6,135	9,797
California	27,838	49,093	29,827	34,667	57,665	83,760
Colorado	8,776	16,543	6,798	9,241	15,574	25,784
Connecticut	2,711	7,799	1,837	1,414	4,548	9,213
Delaware	2,380	3,784	760	660	3,140	4,444
D.C.	-	-	-	-	-	-
Florida	33,194	74,967	4,039	6,483	37,233	81,450
Georgia	3,100	8,095	3,519	6,224	6,619	14,319
Hawaii	-	-	143	460	143	460
Idaho	5,220	5,578	3,219	2,776	8,439	8,354
Illinois	19,787	27,242	7,345	11,462	27,132	38,704
Indiana	19,039	25,313	4,846	10,798	23,885	36,111
Iowa	4,308	6,849	4,644	13,434	8,952	20,283
Kansas	1,732	2,838	956	7,980	2,688	10,818
Kentucky	4,913	12,824	2,680	6,942	7,593	19,766
Louisiana	1,982	7,267	518	1,500	2,500	8,767
Maine	12,789	17,769	1,759	1,734	14,548	19,503
Maryland	3,169	5,678	1,213	2,791	4,382	8,469
Massachusetts	6,703	13,218	2,783	3,323	9,486	16,541
Michigan	12,507	31,524	20,982	25,384	33,489	56,908
Minnesota	11,994	14,744	5,179	7,817	17,173	22,561
Mississippi	1,050	2,311	2,398	3,127	3,448	5,438
Missouri	3,987	15,408	4,383	8,319	8,370	23,727
Montana	5,347	8,996	3,402	6,048	8,749	15,044
Nebraska	2,652	2,535	3,034	6,410	5,686	8,945
Nevada	2,280	5,860	2,050	1,882	4,330	7,742
New Hampshire	7,378	14,444	2,012	2,071	9,390	16,515
New Jersey	8,267	22,972	1,101	1,090	9,368	24,062
New Mexico	2,463	5,368	1,222	2,324	3,685	7,692
New York	23,496	40,318	10,298	14,623	33,794	54,941
North Carolina	13,341	19,356	3,713	4,186	17,054	23,542
North Dakota	802	1,303	1,761	3,792	2,563	5,095
Ohio	27,515	42,564	7,540	12,899	36,055	55,463
Oklahoma	1,297	2,698	7,323	9,241	8,620	11,939
Oregon	7,503	9,889	11,113	13,901	18,616	23,790
Pennsylvania	20,234	38,507	3,981	9,567	24,215	48,074
Rhode Island	949	3,109	818	1,182	1,767	4,291
South Carolina	10,392	15,446	1,193	3,218	11,585	18,664
South Dakota	5,909	6,802	3,506	3,786	9,415	10,588
Tennessee	6,255	13,017	4,184	4,759	10,439	17,776
Texas	8,479	40,698	5,246	13,200	13,725	53,898
Utah	2,615	6,843	3,994	4,481	6,609	11,324
Vermont	3,390	5,356	2,072	2,249	5,462	7,605
Virginia	15,838	20,669	5,124	4,944	20,962	25,613
Washington	14,435	15,130	10,088	9,702	24,523	24,832
West Virginia	1,307	3,681	1,113	2,680	2,420	6,361
Wisconsin	21,293	30,546	9,950	12,253	31,243	42,799
Wyoming	5,969	5,749	4,426	5,746	10,395	11,495
U.S.A. Totals	425,616	774,136	230,395	339,374	656,011	1,113,510

Woodall base rate survey by states

Base Rates	$3.00 or less	$3.50	$4.00	$4.50	$5.00	$5.50	$6.00	$6.50	$7.00	$7.50	$8.00	$8.50	$9.00	$9.50	$10.00	$10.50	$11.00	$11.50	Total Reporting	Not Available	Total Campgrounds	Mean Base Rate
Alabama	4	1	7	4	18	5	12	0	5	0	1	0	0	0	0	0	0	0	57	0	57	5.00
Arizona	36	2	18	15	35	19	54	23	27	9	10	5	3	0	0	0	0	0	256	0	256	5.50
Arkansas	7	1	15	6	25	7	14	4	10	3	1	0	0	0	0	0	0	0	93	0	93	5.00
California	46	6	21	17	107	55	140	49	78	29	39	17	11	6	0	0	0	0	621	0	621	5.50
Colorado	7	6	18	24	50	27	41	20	16	5	3	0	0	0	0	0	0	0	217	0	217	5.00
Connecticut	3	1	3	1	13	4	14	8	8	2	6	0	0	0	0	0	0	0	63	0	63	5.50
Delaware	0	1	0	4	0	5	3	2	0	1	1	1	0	0	0	0	0	0	18	0	18	5.50
Florida	197	1	5	5	45	22	54	28	39	17	18	8	8	4	0	0	0	0	451	0	451	5.00
Georgia	6	2	10	13	20	10	18	10	6	1	2	0	1	0	0	0	0	0	99	0	99	5.00
Idaho	7	3	11	7	29	13	31	12	1	1	1	1	0	0	0	0	0	0	117	0	117	5.00
Illinois	13	3	22	12	38	20	36	13	14	4	3	0	0	0	0	0	0	0	178	0	178	5.00
Indiana	21	6	28	24	33	14	24	12	4	0	0	0	0	0	0	0	0	0	166	0	166	5.00
Iowa	6	4	9	12	17	7	11	2	0	0	1	0	0	0	0	0	0	0	69	0	69	5.00
Kansas	5	5	5	7	14	8	7	0	0	1	0	0	0	0	0	0	0	0	52	0	52	5.00
Kentucky	8	3	9	6	17	10	10	5	2	0	0	1	0	0	0	0	0	0	71	0	71	5.00
Louisiana	6	5	6	4	17	5	15	7	6	4	4	0	1	0	0	0	0	0	80	0	80	5.00
Maine	6	2	15	18	39	20	37	14	29	5	2	1	0	1	0	0	0	0	189	0	189	5.00
Maryland	2	1	5	3	10	6	10	3	4	2	2	0	1	0	0	0	0	0	49	0	49	5.50
Massachusetts	5	0	4	7	25	8	27	7	17	0	2	1	2	0	0	0	0	0	105	0	105	5.50
Michigan	25	8	30	29	78	43	73	30	25	7	6	2	4	2	0	0	0	0	362	0	362	5.50
Minnesota	8	9	31	24	81	35	46	16	15	3	0	1	0	0	0	0	0	0	269	0	269	5.00
Mississippi	5	2	3	4	15	3	5	1	2	1	4	0	0	0	0	0	0	0	45	0	45	5.00
Missouri	14	17	38	27	57	23	23	8	8	2	1	0	0	1	0	0	0	0	219	0	219	5.00
Montana	7	8	25	21	39	16	21	7	6	2	1	0	0	0	0	0	0	0	153	0	153	5.00
Nebraska	4	1	9	5	10	3	10	1	1	0	0	0	0	0	0	0	0	0	44	0	44	5.00
Nevada	11	2	3	2	14	3	10	5	12	1	3	3	0	0	0	0	0	0	69	0	69	5.00
New Hampshire	2	0	13	9	35	25	44	13	13	3	2	0	0	0	0	0	0	0	159	0	159	5.50
New Jersey	6	0	1	2	13	12	24	10	23	3	8	3	3	3	0	0	0	0	111	0	111	5.50
New Mexico	[illegible]	3	7	10	17	10	26	10	[illegible]	1	2	0	0	0	0	0	0	0	98	0	98	5.00
New York	29	10	36	43	88	47	63	24	24	7	9	1	4	0	0	0	0	0	385	0	385	5.00
North Carolina	10	3	18	13	52	28	62	12	20	3	7	2	0	0	0	0	0	0	230	0	230	5.50
North Dakota	4	2	4	7	2	3	1	0	0	0	0	0	0	0	0	0	0	0	23	0	23	4.50
Ohio	17	5	35	31	69	21	52	20	14	1	1	0	2	0	0	0	0	0	268	0	268	5.00
Oklahoma	7	2	6	5	16	5	8	6	3	1	0	0	0	0	0	0	0	0	59	0	59	5.00
Oregon	13	7	29	14	50	16	53	10	8	2	1	0	0	0	0	0	0	0	203	0	203	5.00
Pennsylvania	12	13	41	40	80	34	57	17	23	3	5	4	6	0	0	0	0	0	335	0	335	5.00
Rhode Island	0	1	2	1	6	5	4	2	1	0	2	0	0	0	0	0	0	0	24	0	24	5.50
South Carolina	8	0	8	3	14	8	9	5	9	3	2	1	1	0	0	0	0	0	71	0	71	5.00
South Dakota	4	2	13	9	22	10	18	5	1	3	1	0	0	0	0	0	0	0	89	0	89	5.00
Tennessee	11	5	11	16	42	8	23	7	12	3	2	1	1	0	0	0	0	0	142	0	142	5.00
Texas	44	19	42	47	149	63	109	32	18	14	8	3	2	0	0	0	0	0	550	0	550	5.00
Utah	4	2	7	4	28	12	27	3	7	1	0	1	0	0	0	0	0	0	96	0	96	5.50
Vermont	6	5	9	13	23	7	8	2	1	0	1	1	1	0	0	0	0	0	77	0	77	5.00
Virginia	9	0	7	10	24	15	47	24	15	5	2	2	0	0	0	0	0	0	160	0	160	6.00
Washington	20	9	40	27	82	31	45	11	14	3	6	2	0	0	0	0	0	0	290	0	290	5.00
West Virginia	7	6	15	5	9	3	4	2	4	0	0	0	0	0	0	0	0	0	54	0	54	4.50
Wisconsin	20	12	39	45	81	50	59	23	9	6	3	1	2	1	0	0	0	0	351	0	351	5.00
Wyoming	6	2	5	5	24	14	23	4	11	0	2	0	0	0	0	0	0	0	96	0	96	5.50

No data available from Hawaii.

Alaska reported 33 campgrounds, but no base rate data

Central America reported 17 campgrounds, but no base rate data

No data available from Northwest Territories

I Data gathered in 1979 for the 1980 Woodall's Campground Directory

Appendix 3

1979 U.S. FACILITIES DATA, BOTH RECREATIONAL AND PHYSICAL FACILITIES

FACILITIES	Number of Parks
Total sites	858,372
Total with full hookups	366,841
Total with elec & water hookups	317,746
Total with electric hookups	49,916
Total with no hookups sites	118,705

Number of Parks:

With season lease sites	3,100
With pull-thrus	4,656
With cable TV	429
With RV length of less than 33 feet	954
That accept full hookup units only	756
That exclude tents	966
That exclude tent trailers	146
That exclude motorhomes	6
That exclude vans	37
That exclude pickup campers	11
That exclude fifth wheel	16
That exclude travel trailers	13
That exclude motorcycles	1,095
With flush toilets	8,297
With chemical toilets	193
With pit toilets	856
With marine/recirculating toilets	53
With hot showers	8,242
That charge for hot showers	1,192
With cold showers	36
With basins	8,334
With dump station	0
That charge for dump station	0
With dump facility	6,035
With portable dump	438
With a laundry	5,367
With public phone	5,899
With phone available	2,788
With limited grocery	2,736
With grocery	1,424
With full service store	313
With RV supplies	2,024
With LP gas refill	2,527
With gasoline	1,199
With marine gas	543
With ice	6,025
With picnic tables	7,199
With patios	1,303
With fire areas	1,512
With bowling lanes	3
With pony rides	55
With playground	4,160
With handball courts	20
With horseriding trails	217
With horseriding rentals	199
With fire rings	2,506
With grills	1,496
With wood	3,964
With babysitting service	281
With church services	822
With recreation halls	2,356
With recreation halls for teens	98
With recreation halls for adults	216
With recreation rooms	3,170
With recreation rooms for teens	157
With recreational rooms for adults	114
With pavilions	1,297
With pavilions for teens	6
With pavilions for adults	10
With swimming pool	5,290
With more than 1 swimming pool	181
With indoor pools	65
With outdoor pools	0
With heated pools	1,171
That charge for swimming	191
With lake swimming	1,511
With ocean swimming	152
With river swimming	384
With pond swimming	349
With a sauna	103
With therapy pool	275
With water slides	100
With boating	2,608
With electric motors only	146
With no motors	432
With motorized launch	28
With boat ramp	1,486
With boat dock	1,526
With row boat rentals	1,560
With sail boat rentals	66
With canoe rentals	817
With pedal boat rentals	508
With ocean fishing	262
With lake fishing	2,146
With river fishing	1,362
With pond fishing	943
That charge for fishing	217
With 9-hole golf	29
That charge for 9-hole golf	25
With 18-hole golf	15
That charge for 18-hole golf	16
With par-3 golf	28
That charge for par-3 golf	15
With mini-golf	539
With driving range	36
With putting greens	48
With basketball courts	400
With more than one basketball court	83
With bike rentals	450
With ice skating rinks	15
With planned group activities	1,239
With a recreation director	325
With platform tennis	5
With racquet ball courts	8
With roller skating rink	20
With shuffleboard court	1,452
With tennis court	429
With more than 1 tennis court	330
With an archery range	54
With badminton	1,656

Number of Parks, Cont.

With batting cages	13
With croquet	274
With fishing guides	148
With float trips	121
With horseshoes	3,861
With motor bike trails	250
With nature hikes	894
With ski rentals	35
With cross country skiing	185
With downhill skiing	17
With scuba diving	50
With snowmobile trails	315
With snowmobile rentals	27
With volleyball	2,719
With water skiing	831
With local tours	230
With recreation open to non-camping public	1,023

RESTRICTIONS

Number of Parks:

That do not allow pets	307
Limited to adults only all year	440
Open all year	5,401
With 3 day minimum stay	5
With 7 day maximum stay	16

CBs

Number of Parks:

With CB channel monitored all year	0
With CB channel monitored 24 hours	0

CLASSIFICATION:

Number of campgrounds	6,078
Number of RV parks	1,019
Number of RV areas in a mobile home park	425
Number of RV spaces	1,901
Number of primitive campgrounds	61
Number of parks that require reservations	851
Number of planned & under construction parks	134
Number of rebuilding parks	51
Number of new parks	232

INDUSTRY SOURCES OF TREND DATA -- SKIING[1]

William F. Malcolm, Jr.
Chief Planner
Sno-Engineering Inc.
Resource Management
Post Office Box 65
Franconia, NH

OVERVIEW

With precious few exceptions, ski industry trend data does not exist. This paper will enumerate sources of trend data known to the author. The paper considers the probable causes of the lack of ski industry trend data and means to ameliorate the lack of trend data. Finally, the paper presents a rationale for acquiring improved ski industry trend data.

SKI INDUSTRY TREND DATA

The National Ski Areas Association (NSAA) sponsors an annual research/survey study entitled "Economic Analysis of North American Ski Areas", which reports the financial condition and operating characteristics of more than 50% of the American ski area capacity.[2]

The US Forest Service maintains annual pricing, usage and capacity data[3] on ski areas operating under special use permits. Although the capacity calculations have come under some criticism, the report does contain factual, unaggregated, area-specific skier visits and published ticket price information.

Periodically, the AC Nielsen Co.[4] has reported on the ski industry either in the context of overall outdoor recreation activity, or as an industry specific project.

Many ski industries[5] have supported or cooperated with researchers investigating their own skiers, resulting (in some cases) in annual skier "profiles".

Many recreation researchers[6] have been active in ski industry analysis during the past several years. Although not necessarily sources of trend data per se, these researchers do have a historical perspective that could be invaluable resources for certain types of investigation.

A number of universities and colleges have recreation or natural resources planning programs that either maintain bibliographic catalogues[7] of ski industry studies, or actively publish and distribute industry specific monographs. Collectively, these monographs are a form of trend data.

PROBABLE CAUSE FOR THE LACK OF SKI INDUSTRY TREND DATA

The "supply side" of the ski industry is characterized by many relatively small "producers". No one supplier or group of suppliers dominates (in terms of market share) the supply of alpine skiing. Most ski areas are, by definition, "small businesses" and many are owned and operated as a family business.

Although there is some movement towards large corporate acquisitions (20th Century Fox, Ralston-Purina, etc.) and mergers between ski areas (Sugarbush and Glen Ellen, Stratton and Bromley, etc.) the vast majority of ski areas in North America are owned and operated by entrepreneurs. These entrepreneurs are generally good day-to-day managers, but many times lack the capital base for major expansion.

The larger areas conduct their own, albeit limited, demand research to satisfy marketing planning expansion requirements. Smaller areas rely heavily on the intuition of management and the extrapolation of past performance.

Thus the fragmented nature of the supply function, coupled with varying management priorities has not lead to the creation of a sophisticated on-going mandate for either supply or demand side trend data research. The exception may be a general support of the research by NSAA in its annual "Economic Analysis of North American Ski Areas".

AMELIORATION OF TREND DATA RESEARCH

As noted above, the NSAA "supply side" "Economic Analysis" presents a relatively comprehensive look at the ski industry over time. The primary improvement to this excellent resource would be broader industry participation. Perhaps this could be achieved by heavier promotional efforts or more persistent followup techniques.

The US Forest Service study noted above is helpful (although limited to those on Forest Service land) and could be improved by rationalizing the capacity component through more rigorous, uniform criteria and more comprehensive evaluative techniques.

Demand side trend research will require a "major" supporter to provide the continuing resources necessary to achieve the inherent objectives. Many vehicles are available inside and outside the industry. The absence of demand trend data is clear; the necessity is stated below.

RATIONALE (NECESSITY) FOR IMPROVED SKI INDUSTRY TREND DATA

Significant public and private capital and human resources are employed in delivering the recreational activity focused on snow skiing. To the extent we wish to maximize the return on capital and labor, we need to know how to create the desired product or products. Or, expressed from the perspective of the skier, "Who will offer what I want, when I want it, at a price that I feel is reasonable?" It is this arbitrage between knowledgeable suppliers and knowledgeable consumers (whether active, potential, or drop-out) that will result in a healthier, more vigorous, socially useful industry.

FOOTNOTES

[1] Paper presented at the National Outdoor Recreation Trends Symposium, Durham NH, April 20-23, 1980.

[2] ECONOMIC ANALYSIS OF NORTH AMERICAN SKI AREAS: 1977-78 SEASON. C.R. Geoldner and Ted Farwell. Business Research Division, Graduate School of Business Administration, University of Colorado, Boulder, CO. 1978. 140 pp. $30.

[3] US Forest Service Pricing Study Printout. August 1979.

[4] CONFIDENTIAL REPORT ON THE SPORT OF SNOW SKIING. Nielsen Custom Research Service, AC Nielsen Co., Nielsen Plaza, Northbrook, IL. 1979.

[5] THE ASPEN SKIER: 1977-78 SEASON. C.R. Goeldner, Business Research Division, University of Colorado, Campus os 420, Boulder, CO. 1978. 80 pp. $15.

THE BRECKENRIDGE SKIER. C.R. Goeldner and Yvonne Sletta, Business Research Division, University of Colorado, Boulder, CO. 1975. 67 pp. $10.

THE COLORADO SKIER: 1977-78 SEASON. C.R. Goeldner, Business Research Division, University of Colorado, Boulder, CO. 1978. 92 pp. $25.

THE COPPER MOUNTAIN SKIER, 1978-79. C.R. Goeldner and Jack Harrington, Business Research Division, University of Colorado, Boulder, CO. July 1979. 68 pp.

THE 1977-78 STEAMBOAT SKIER SURVEY. Charles K. Mayfield, Steamboat LTV Recreation Development, Bos 1178, Steamboat Spgs., CO. 1978. 88 pp.

THE VAIL SKIER: 1977-78 SEASON. C.R. Goeldner, Business Research Division, University of Colorado, Boulder, CO. 1978. 106 pp. $15.

THE WINTER PARK SKIER: 1978-79 SEASON. C.R. Goeldner and Jack Harrington. Business Research Division, University of Colorado, Boulder, CO. June 1979. 49 pp.

[6] BIBLIOGRAPHY OF SKIING STUDIES. C.R. Goeldner and Karen Dicke. Business Research Division, University of Colorado, Boulder, CO. 1978. 62 pp. $10.

[7] Ibid.

SKI UTAH: A REPORT OF THE INDUSTRY. John D. Hunt and Christie Anderson. Institute for Outdoor Recreation and Tourism, Utah State University, Logan, UT. February 1976. 111 pp. $10.

WINTER RECREATION VISITOR STUDY, WISCONSIN. Rollin B. Cooper, Sue Sadowske, and Mark D. Kantor. Recreation Resources Center, University of Winconsin-Extension, 1815 University Avenue, Madison, WI. 1979.

TRENDS IN PARTICIPATION SPORTS DURING THE DECADE OF THE 70'S[1]

Robert J. Halstenrud[2]

Abstract.--Five nationwide surveys to determine participation in popular sports have been conducted since 1970. These, plus subsequent ones in the 1980's, will be useful to advertising agencies, the sporting goods industry and government planners. Swimming, bicycling, camping, fishing, and bowling have consistently held the top five spots. Jogging and tennis have recently moved into the top ten spots. Demographic changes, economic conditions and the energy situation may affect results of future participation surveys.

During the past ten years, the A.C. Nielsen Company has conducted five nationwide surveys designed to determine the estimated number of persons who are participating in several of the more popular sports. The first study, conducted in 1970, was a modest beginning which included only thirteen sport activities. The 1970 data were collected from respondents using the face-to-face personal interview approach. Three years later, in 1973, the second survey was conducted and coverage was increased to twenty-five sport categories. When launching the 1973 study a telephone interview, carried out in the quality-controlled environment of a centralized WATS facility, became the data collection method. These same telephone interviewing procedures have been used consistently in all of the subsequent studies of sports participation and, primarily for this reason, the 1973 survey serves as the benchmark for trending the results as measured in subsequent studies conducted during the 70's.

In 1974, widespread interest in tennis prompted a special, in-depth study designed to provide additional insights for this fast-growing market.

The fourth national study in 1976 represented a return to the conventional type of sports participation research, using the 1973 procedures, in order to report trends in a proper and consistent manner. Coverage was increased to 27 recreational sports. The 1979 survey is the fifth major piece of research conducted in connection with our on-going sports research program. This most recent study included 30 sport categories, of which 23 are common to all of the surveys carried out in 1973, 1976, and 1979. Using 1973 as the base or benchmark year, the three-year intervals between each of the major studies form the framework for trending the estimated number of participants in the various sports measured during the decade of the 70's.

As each study is conducted, a separate report is prepared for each sport category. Of course, the primary study objective is to provide a continuing and consistent research effort in the field of leisure-time participant sport activities. Having accomplished this purpose, one of the several major objectives is to develop projected estimates and trends of the total number of participants in the United States. Having identified the participants in each respective sport category, another of the objectives is to profile the players by several demographic characteristics such as age, sex, education, annual household income and geographic location. Frequency of participation is obtained to classify the participants into categories of "heavy", "medium" and "light" players. These levels of play are then profiled to determine whether and to what extent differences may exist that can be used as tools in marketing the sport to specific target groups.

The objective of using the survey data to predict the future number of participants in any given sport is another value inherent in the Nielsen studies. In our opinion, this predictive feature will become of greater significance as more studies are conducted during the upcoming decade of the 80's. These new measurement periods will add to our present bank of data to establish long-term trends which can be correlated with other known variables and tracking measures that are maintained over time in order to predict more accurately the future number of participants.

---

[1] Paper presented at the National Outdoor Recreation Trends Symposium, Durham, NH, April 20-23, 1980.

[2] Manager, Nielsen Developmental Syndicated Surveys, A.C. Nielsen Company, Nielsen Plaza, Northbrook, IL 60062.

The combination of all of these objectives determines those all-important marketing strategies that are needed for a particular sport to sustain itself as a growing and successful activity operating in a competitive environment with other participant-type sports as well as other types of leisure-time activities from which consumers have to choose. Finally, depending upon the nature of the sport, some of our other study objectives include information on equipment purchases, years of participation, ownership of equipment requiring a fairly substantial purchase investment, and the extent of accidents and/or injuries associated with participation in the sport.

In the 1979 survey, interviews were completed with 3,003 households within the Continental United States. Cooperating respondents (male or female head of the household) provided information about the sports participation habits of 9,019 persons living in those homes. The sample was designed using a modified random-digit-dial process to select the households that were interviewed. To implement this plan, a sample of listed telephone households is selected proportionate to total household population by county across the 48 contiguous United States. From this selection, the area code, prefix and first digit of the suffix were used to identify working banks of telephone numbers. Random numbers were generated by computer and substituted for the last three digits of each suffix to produce the final telephone sample. This randomization procedure insures that a high proportion of unlisted and newly listed telephones are represented.

To correct for any sample imbalances in projecting the sports participation levels to the total household and person populations of the contiguous 48 states, the projection factors were computed for each sample cell examined to bring the projections into proper alignment with the universe estimates. For households, projection factors were produced by county size within state. The projection factors for household persons were computed by four United States census regions and within each region by sex and age categories. Through this weighting and projection process, it was possible to bring the surveyed sample in line with the census estimates.

Now for a quick look at definitions. A "participant" or "player" is defined as any person who participates in an activity or plays a sport from time to time during the past twelve months. Within each sport category, there are also standard definitions that are used to identify players as being "heavy", "medium", and "light", depending upon their frequency of participation. A "participant or player household" is defined as having one or more members who engage in an activity or play a sport from time to time during the past twelve months.

While these qualifying definitions have been used consistently in all of our sports surveys, it is possible for users of Nielsen research to establish different participant criteria other than those described. For example, some organizations may determine that part or all of the "light" participant category as defined may not represent a viable target market for their products and/or services. Under such circumstances, it is possible to adjust the estimated number of participants and their respective profiles according to the revised definition.

Let's look at the trends in participation sports by their popularity rankings (Table 1). Swimming is the number one sport in the ranking of popularity. Bicycling has maintained the number two position in popularity in each of the survey measurement years. Camping was ranked fourth in 1973 and 1976. This activity has been growing in the number of participants during the decade of the 70's and has moved into the third most popular position in 1979, replacing the sport of fishing, which has been holding steady in terms of participants. Others in the top-ten ranking of popularity include bowling, boating (other than sailing), jogging/running (measured for the first time in 1979), tennis, pool/billiards, and softball. Overall, nine of the top ten sports have been included in all three studies; and six of the nine have shown player growth during the 70's, while three categories have held steady.

Roller skating, another newcomer in 1979, achieves a popularity ranking of twelve. Water skiing, shown in 1979 to be 16th in popularity, is actually in the 14th spot among the sports that have been included in all of the measurement years. Snow skiing is ranked 18th, but it is 16th among the sports common to all three studies. Without question, water skiing and snow skiing have continued to move up in popularity since 1973. Table tennis and ice skating are moving downward in popularity, while the others in this group are holding their respective positions when the categories measured for the first time in 1979 (jogging/running and roller skating) are removed from the comparisons

Racquetball is ranked twenty-first in popularity and leads the list of sports included in the third group of ten. Actually, on a 1976 to 1979 common base of twenty-seven sports (that is not including the new categories added in 1979), racquetball in 1979 would rank nineteenth in popularity compared to being in the twenty-fourth position in 1976. Soccer was added to the list of sports measured in 1979, and is ranked twenty-fifth among the thirty categories in the study.

Table 1.--1979 popularity of participation sports -- top-thirty rankings

Activity	1973	1976	1979
Swimming	1	1	1
Bicycling	2	2	2
Camping	4	4	3
Fishing	3	3	4
Bowling	5	5	5
Boating (Other than sailing)	8	7	6
Jogging/running[a]	-	-	7
Tennis	12	9	8
Pool/billiards	7	6	9
Softball	9	10	10
Table tennis	6	8	11
Roller skating[a]	-	-	12
Basketball	11	11	13
Hunting	13	13	14
Ice skating	10	12	15
Water skiing	17	17	16
Golf	14	14	17
Snow skiing	20	18	18
Baseball	15	15	19
Football	16	16	20
Racquetball[b]	-	24	21
Motorbiking/motorcycling	18	19	22
Sailing	21	21	23
Snowmobiling	19	20	24
Soccer[a]	-	-	25
Handball[b]	-	23	26
Archery	22	22	27
Paddle tennis[b]	-	26	28
Ice hockey	23	25	29
Platform tennis[b]	-	27	30

[a] Not measured in 1973 and 1976.

[b] Not measured in 1973.

Even more important than the trends in the ranking of popularity are the trends as expressed by the actual number of estimated participants. The thirty sports have been divided into two major categories--team sports and individual-type sports. Simply defined, a team sport is an activity normally associated with a group effort, which allows player substitutions. Individual-type sports are those activities generally considered to be a singular effort (or perhaps a double-player endeavor) with no substitution of participants.

In the next series of figures, each sport is represented by a series of three vertical bars. The bar on the left sets forth the estimated number of projected participants, in millions, as measured by our 1973 benchmark survey. The middle bar is the projected figure from the 1976 survey, and the third bar relates the 1979 projection.

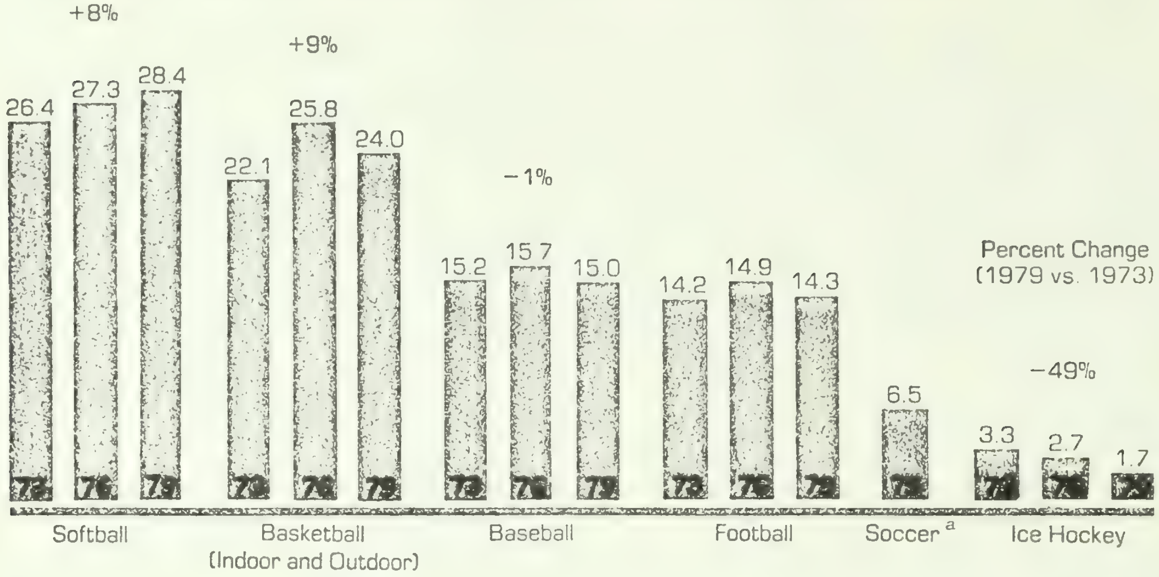
Among the team sports included in the Nielsen surveys (Figure 1.), softball is the most popular, and currently boasts a total of about 28.5 million players. This estimate is up about 8 percent from the 26.4 million projected in 1973. Basketball participation (including both indoor and outdoor play) is now at a level of 24 million, which is about 9 percent higher than the 22.1 million figure reported in the 1973 base-year study. Baseball and football trends are quite similar with the number of participants holding fairly steady at levels of just over 15 million and 14 million, respectively. Soccer, measured for the first time in 1979, appears to be coming on strong in the United States; the current estimate of participants is about six and one-half million. Ice hockey participation has been in a downward slide since 1973, going from 3.3 million players in the base year down to 2.7 million in 1976, to about 1.7 million in 1979.

To summarize the team sport trends during the 1970's, softball has shown consistent increases in the number of players across each of the measurement years. The remaining team sports reveal some modest declines in participation from 1976 to 1979. This is believed to be a reflection of the decline in the ranks of teenagers that has taken place during the late 70's. Softball, on the other hand, continues to be played by both males and females beyond the high school and teenage years.

Figures 2a and 2b depict trends in individual-type sports that have shown growth in number of participants since 1973. It should be noted the sports are listed in order from left to right by popularity and not by their respective growth records. Bicycling, camping, bowling, and boating (other than sailing) have shown participant increases ranging from 6 percent to 16 percent since the base year study of 1973. Note the trend in the number of bicyclists; overall, an increase of about 6 percent is reported from 1973 to 1979. However, the projected number of bikers was down to about 70 million in 1979 from the 75 million as measured in 1976. If a new study was to be conducted in the spring of 1980, it is believed the number of bicyclists would be up to some degree over the 70 million reported in the spring of 1979, primarily because of the recent gas shortages and the dramatic increase in gasoline prices.

For the sport of tennis, there are four bars of projected survey information because of the special, in-depth study conducted in 1974. In the course of just one year -- from 1973 to 1974 -- the number of tennis players surged from 20.2 million to 33.9 million, then the projected figure retrenched somewhat to 29.2 million in 1976 and recovered well in 1979 to a level of 32.3 million participants. Overall, the 1979 projection represents a healthy increase of 60 percent for the tennis category when compared to the benchmark year of 1973.

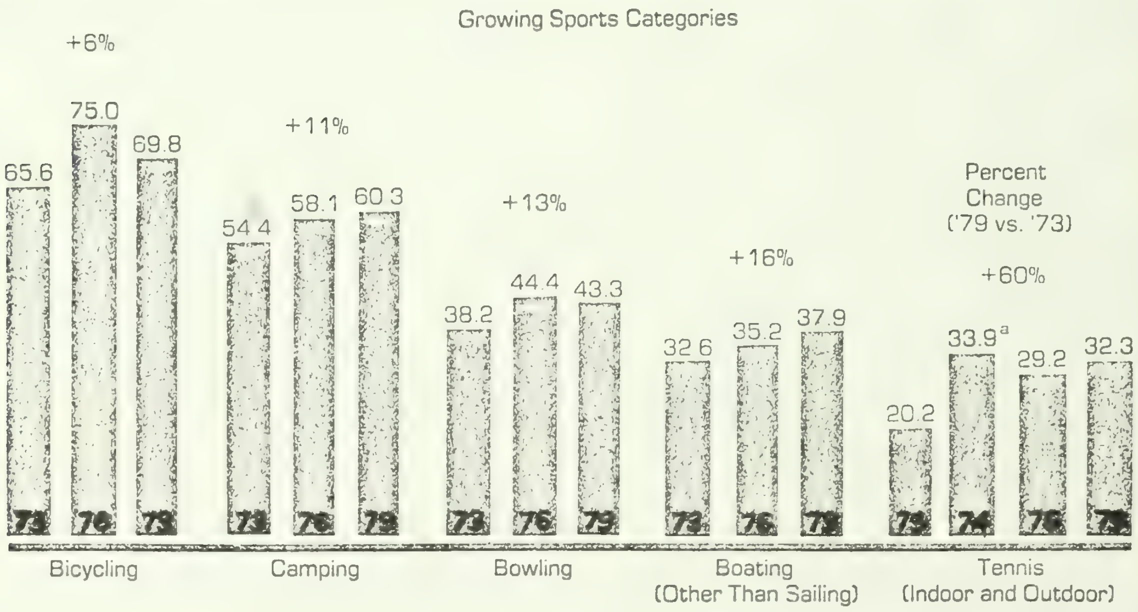
FIGURE 1.-- Trends in Team Sports — 1973 to 1976 to 1979 (Millions)



---

[a] Not measured in 1973 and 1976.

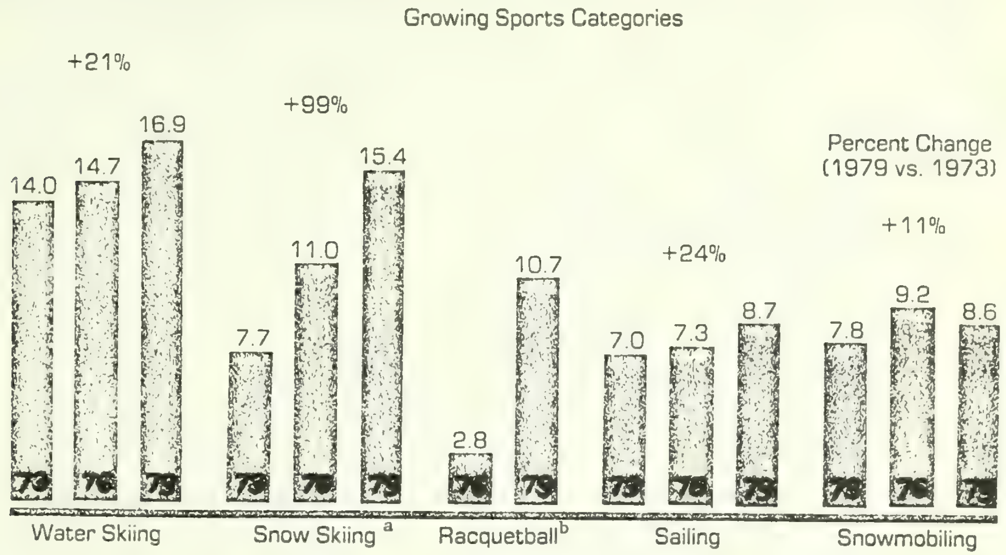
FIGURE 2A.-- Trends in Individual-Type Sports — 1973 to 1976 to 1979 (Millions)



---

[a] Special in-depth study.

FIGURE 2B.-- **Trends in Individual-Type Sports — 1973 to 1976 to 1979 (Millions)**



[a] Includes downhill and cross-country.

[b] Not measured in 1973.

Without question, racquetball is the fastest growing sport of the 70's, with participation skyrocketing to 10.7 million players in 1979 from about 2.8 million fans in 1976. Snow skiing, which includes both downhill and cross-country, is number two in growth since 1973, going from 7.7 million skiers in 1973 to about 11.0 million in 1976 to 15.4 million in 1979--a 99 percent increase over the six-year span of time from 1973 to 1979. Water skiing and sailing represent two other categories with very respectable growth records.

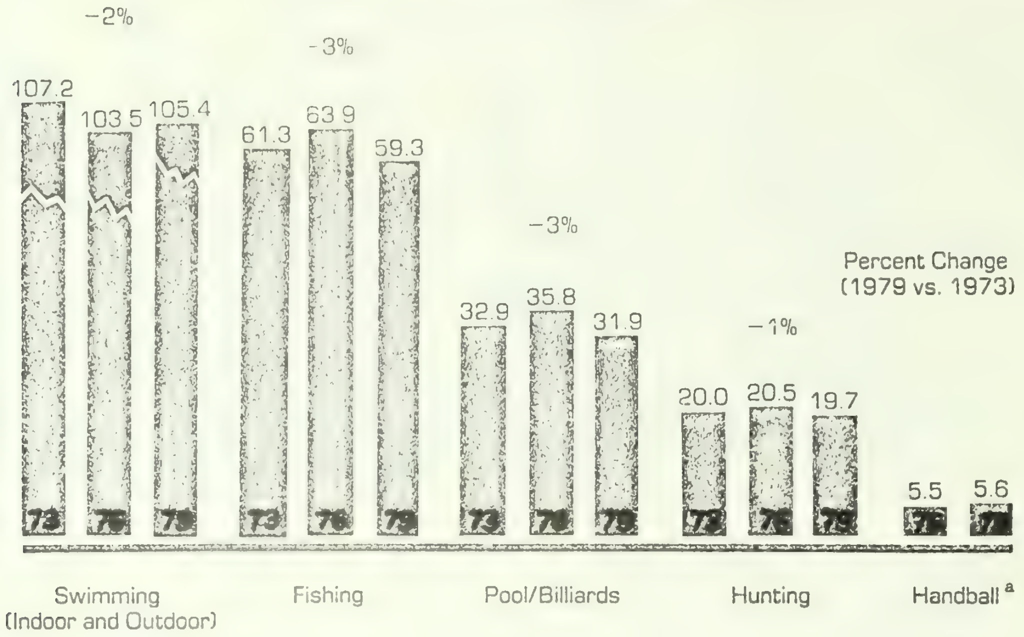
Those sport activities that classify as "holding steady" during the decade of the 70's include swimming (both indoor and outdoor), fishing, pool/billiards, hunting, and handball (Figure 3.). Swimming, which holds the number one ranking in popularity, is a leisure time activity that has maintained consistently over the three surveys a level of over 100 million participants. Handball, a close relative of racquetball, has about 5.6 million players and this estimate is holding steady with the projected number of 5.5 million in handball participants as reported in 1976.

Among the declining sports (Figure 4), there are two categories that are down dramatically in number of participants. Table tennis, which currently claims about 27 million players, is off about 20 percent from the 33.5 million persons who participated in 1973; and ice skating, while increasing somewhat in number of participants from 1973 to 1976, has closed out the 70's with a substantial reduction to 18.9 million. The activities of golf, motorbiking/motorcycling, and archery are trending downward in the number of participants since 1973. Actually, the declines for these three categories are not all that dramatic; and since there is evidence of some stability, there are no doubt some observers who might choose to classify these activities as "holding steady" rather than positioning them in the category of declining sports for the decade of the 70's.

Our written reports on each activity contain the 1979 demographic profiles of the participants, as well as the demography measured in the studies conducted prior to the 1979 survey. This back data makes it possible to track the trends that have taken place in these demographic variables. Demographic shifts over time have enormous implications for business, in terms of developing marketing plans and designing marketing promotions and advertising targeted to specific audiences and/or population groups. Having an awareness of the demographic trends that are taking place over time, marketers can examine their significance and begin to make some judgements concerning their impact upon the future.

FIGURE 3.-- **Trends in Individual-Type Sports — 1973 to 1976 to 1979 (Millions)**

Holding Steady Sports Categories

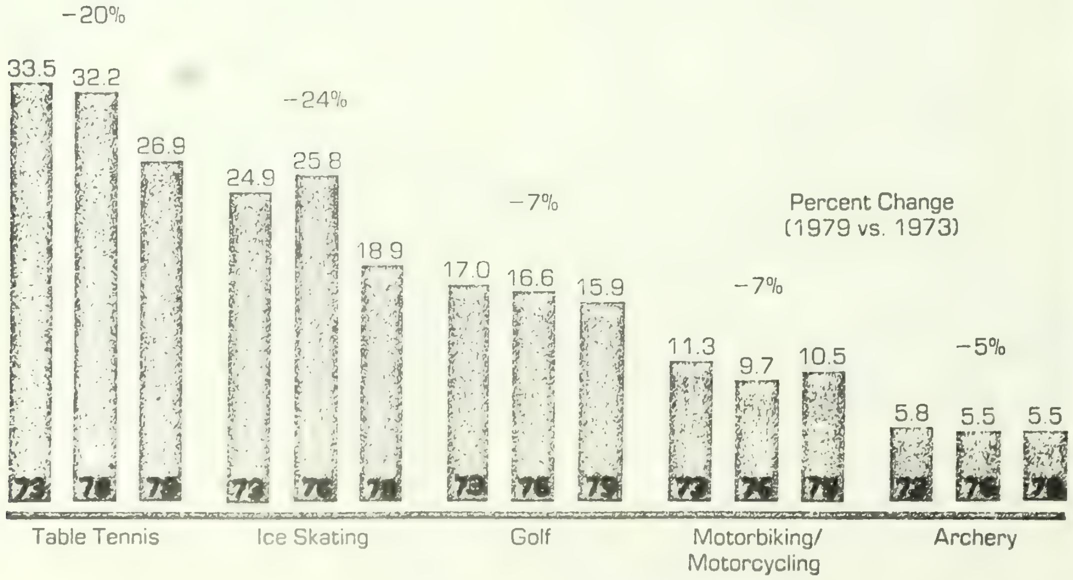


---

[a] Not measured in 1973.

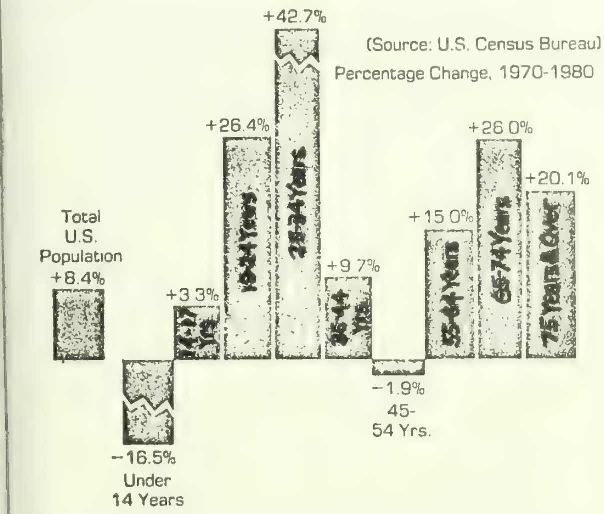
FIGURE 4.-- **Trends in Individual-Type Sports — 1973 to 1976 to 1979 (Millions)**

Declining Sports Categories



In moving from the end of one decade to he beginning of another, several articles ave appeared in newspapers and magazines ealing with the demographic direction of the opulation in the United States. These decade-o-decade comparisons are helpful in developing perspective for future planning. For example, he United States Census Bureau provides us ith age changes in our population that took lace from 1970 to 1980 (Figure 5). During he 70's, the overall population of the United tates increased 8.4 percent. The biggest pward shifts in population from 1970 to 1980 ook place among those persons in the age ategories of 18 to 24 years and 25 to 34 years. ince these age classifications also account or a high proportion of racquetball players, t can be concluded the age shifts had a ignificant impact on the growth of racquetball uring the decade.

IGURE 5.--**Population Shifts in the 1970's by Age**

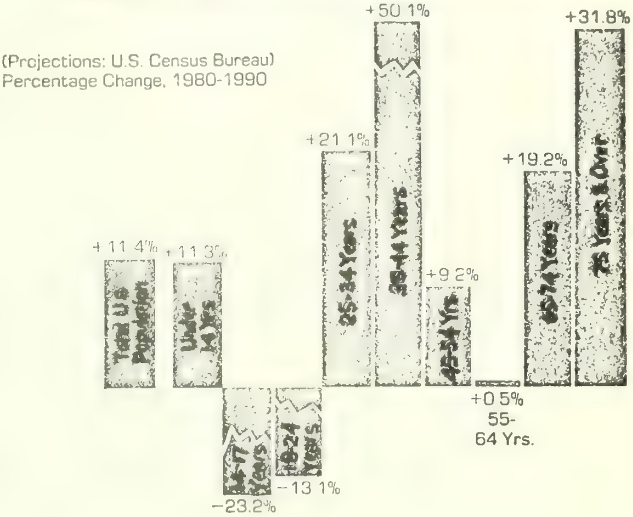


(Source: U.S. Census Bureau)
Percentage Change, 1970-1980

Census Bureau data also tells us of a ather sharp decline in the number of children nder 14 years of age between 1970 and 1980 Figure 5).

Looking ahead to the decade of the 80's, as rojected by the Census Bureau, it is expected ne total population in 1990 will increase by 1.4 percent (Figure 6). Certainly one of the ost dynamic age demographic changes of the 80's ill be in the decline of persons between the ges of 14 and 24. The upward bulge in popula- on for the age categories of 18 to 24 years d 25 to 34 years during the past decade moves primarily to the age category of 35 to 44 ars over the next ten years. Of course, the to 34 year old group is still expected to crease in numbers by about 21 percent ring the 80's. So, when relating the age ifts for the 80's to the age profiles of, t's say, racquetball players as we know em today, it would appear these age changes y continue to have a favorable impact on cquetball player growth during the early 80's; but this trend may begin to have a slowing influence at the close of the decade. Of course, at the same time, marketing of the sport of racquetball during the 80's may also change the trends in player profiles. If this player profile change was to be similar in nature to the age shifts that are expected to be upward, the net result would continue to have a favorable implication on the future of racquetball.

FIGURE 6.--**Population Shifts in the 1980's by Age**



(Projections: U.S. Census Bureau)
Percentage Change, 1980-1990

The next major Nielsen Sports Participation Survey is scheduled for 1982. It is difficult to predict what directions the trends in participant sports will take during the early 80's. We all know there are several variable factors that contribute in one way or another to the increase or decrease in popularity of different sports. Certainly the worsening energy situation in the United States is going to have some adverse effects on trends for some sports while other participant sport categories will benefit. Inflation and its effect upon discretionary income can also have both negative and positive implications on growth.

It is reported that more Americans will have more time available in the coming years for leisure activities. In the minds of these consumers, a participant sport has an image based upon such factors as costs, skills required to obtain a favorable level of player satisfaction and supply availability. These conditions create competition between the sports to garner participants and, thereby, offer a vast array of marketing challenges.

As recreation planners and researchers, you are keenly interested in the supply and demand comparisons. Without question, it can be summarized by the old adage that the only constant is change. Certainly growth cannot be expected to happen by itself. Becoming more perceptive and gaining more knowledge about the recreation industry will provide insights to help in managing this change with even greater efficiency in the 80's.

RECREATION TRENDS - A FUTURE LOOK
"SO WHAT? - IMPLICATIONS FOR THE RECREATION PROFESSION"[1]

Roger A. Lancaster[2]

The art of "crystal-ball gazing" is not an exact science. While it is very useful to discuss what life will be like in the future, and rather fun, I might add, a review of the multitude of materials prepared 20 to 30 years ago about life in the 1980's found little that was all that accurate. The projections that were most on target tended to be those educated guesses about "things" - such as transportation devices, home products, recreational equipment, etc., plus those that could be projected from a specific, sophisticated data base such as demographic projections. The judgments on the future that tended to be the most off the mark were those that dealt with the intangibles - such as individual and societal attitudes. Much of the attitudes presented in Orwell's 1984 are certainly far from the reality of today, and it is doubtful if our current attitudes are going to change enough in the next four years to make Orwell's prophecies come true. This is to be expected, for the intangibles are very difficult to measure. Indeed, to measure changes in attitudes requires sophisticated, complex, long-term research. Most of us lack the time, money, and even inclination to engage in this type of research over an extended period. Perhaps some of the best research on this topic has been in the area of sexual behavior - the interest being generated, perhaps, by the joys inherent in the subject matter.

However, it is in this area of the intangibles -- the additudes, hidden individual behavior, the "human climate," as Philip Lesly refers to it - that the recreation and park profession is going to have to study more losely in the future. There is today a masive shift in the attitudes and posture of the ublic, and I quote Lesly, (1:2):

> The survival of all institutions depends on how this new human climate is managed. The only way anyone can have a say about the future is to learn to manage the human climate. Of all the factors that determine how our system works, the least understood is now clearly the most important--the people factor.

With this in mind, let me give a cursory response to the question that is the title of this talk in the program "So what?: implications for the recreation profession." If we can't manage the human climate; if we can't project and analyze future human climates; then all of the trend projections on the tangibles - the number of people who will be hiking, skiing, boating; the number of parks, campsites and amount of open space we will need; the amount of recreational equipment and number of RV's purchased - may not matter one iota. This is not meant to debase the need for understanding tangible trends; nor is it meant to demean the value of this symposium. What it does mean is that the future of the recreation profession, especially those in the public arena, will be very dependent on the ability of the professional to understand, analyze, and manage the human climate, not only of their own staff, but the public which they serve and to whom they are accountable.

At present, the ability of the recreation profession to deal with the human climate is very limited. We suffer from knowledge gaps. I see relatively few papers on this topic in the program; we lack the skills. Few professional preparation programs deal with this topic in a meaningful way. While we say we are in the "people" business, in reality we are more concerned about carrying capacity, numbers of people participating, grass, trees, and buildings; the tangibles which we can touch and see, and are the easiest to manage.

Yet, there are series of trends and issues today which over the long-term (the next 20 to 30 years) will force us away from dealing with only the tangibles if we want to survive as a profession. While some of these issues might be considered in the "tangible" domain, all of them affect the "human climate." Time does not permit me to go into depth on all of them; however, I do want to spend some time on at least three of these issues.

---

[1] Paper presented at the National Outdoor ecreation Trends Symposium, Durham, NH, April 0-23, 1980.

[2] Director of Research, National Recreation nd Park Association, 1601 Kent Street, rlington, VA.

The first of these is an overwhelming conservativism that I see sweeping throughout the land. The shift in political posture from the left-of-center to the right-of-center is manifested in such recent events as:

- the "back to the basics" movement in education;
- the refusal by many states to consider the ERA, and a rescission in some states of the Amendment;
- the growing anti-abortion movement;
- the current "Jaws II" initiative in California and the Proposition 13 syndrome, which I see extending to many other states and cities in the upcoming elections;
- the resurgence of the Republican Party led by a presidential candidate who epitomizes conservatism; and,
- the current attempts by the Carter administration to balance the federal budget by slicing billions out of social programs, including parks and recreation.

The fiscal constraints engendered by such conservatism strikes right at our ability to provide quality recreation and park experiences to the public whom we serve.

The root cause of this conservatism may be what I would call a "me first" syndrome. A syndrome which we have not seen in this country for some time and one which has led to lessen the value placed on social programsmore than any previous time in this century. The idea of being my brother's keeper, providing services for the public good, and just about anything that resembles a social welfare program, including recreation, is now falling on deaf ears. The taxpayer is revolting; he is more interested in himself than the other person, and if such attitudes continue, then at the risk of being a see'er of doom, I do not see much light at the end of the tunnel for public park and recreation services.

The fiscal conservatism of the "me first" attitude will affect public recreation and park systems in two basic ways. The first is that we are going to be asked to do more with less money and when you combine that with the effect of the energy situation, where more and more people are going to require more and more recreation and park services closer to home, we are being put between a rock and a hard spot. Secondly, the "me first" attitude plus the overwhelming desire of decision makers to improve the economy is going to create some extremely tenuous conflicts on the use of any available open space that we have. The search for new energy sources on existing parkland, the use of land for industrial and commercial development rather than open space and parkland, are going to be battles that we in the park and recreation movement are going to have to face square on, for land lost in such short-term skirmishes will be lost forever.

How recreation managers deal with this aspe of the human climate in the future is open to much discussion and debate. What is known, is that if we had been able to foresee the implications of this shift and adjust our management style accordingly, then we might not have found ourselves in such a dire predicament.

The second major issue is one that I've already mentioned in passing - the energy crisi While this might be considered a "tangible" factor, it does have an "intangible" tinge that will impact on the human climate.

We know that our oil supply is running out it is not an unlimited resource. We can be relatively certain that in time there will be regulations and restrictions placed on the use of petroleum products. Indeed, it's entirely possible that energy-consumptive forms of recreation, such as all of RV's, may be among the first affected. We also know that alternative energy sources are currently available or are technologically feasible, but are not economically feasible. These are all tangible factors.

The intangible factors revolve around people's behavior in times of the reduction of petroleum-based energy. The role of the recreation professional in managing the human climat under such conditions is two-fold.

First, the recreation professional will, l everyone else, be expected to take a part in conserving energy. Undoubtedly, there will be mandatory conservation measures imposed on fro high. However, I am convinced that only throu modifying human behavior will this nation ever reach the point where it has an effective ener conservation program. To this end, the recreation professional should be taking steps to modify the behavior of his/her staff in terms of energy conservation education. As such, th recreation professional has a responsibility t utilize these resources to modify public behav towards energy consumption.

The second intangible factor related to t energy crisis has to do with people's leisure behavior. I firmly believe that in spite of reduced energy resources in the future, people will still search for outdoor recreation exper ences. What will change will be the mode they use to pursue these experiences, and the setti in which they take place. Many of these chang have been discussed during this symposium, and must be heeded by the profession, with due cau given to short-term "fads."

Of greater concern to me, however, is the fact that as people find they cannot escape to the Minnesota backwoods to enjoy hiking, they will turn to settings closer to home, but with the same set of expectations as to what they should receive from the experience as they previously had in their trip to the backwoods. Obviously, the dilemma posed by this situation may never be able to be fully resolved. Yet, the greater the ability of the professional to manage the human climate, the closer he/she will come to a solution.

The third major issue that I see developing is that of a changing clientele. A look at almost any demographic statistical analysis shows that we are becoming an older nation. The children born in the baby boom of post World War II America are now rapidly approaching middle age and by the end of this century will be counted among our senior citizens. To top it off we have almost reached the point of zero population growth, and if you combine this factor with the prospect of many of us being senior citizens in about 30 years, then we are faced with a society that is much, much older and as a result will have many different needs than the society of today. An implication of this for the recreation professional is that the services we provide will, as a result of the changing character of our society, be quite a bit different than what we know today. For example, it is possible that many of our high risk programs will no longer be in vogue. Then many of our more strenuous outdoor recreation pursuits, such as mountain climbing, may decrease in popularity simply because fewer people are capable of either physically or economically pursuing them.

Along with an older society will be a more highly-educated population. A college education is now becoming the general rule rather than the exception. But, along with the obvious benefits of a higher education, come some pitfalls which will become more apparent in the future and have some definite implications for the recreation professional.

We have been taught in our society that a college education will bring certain rewards. It is the epitomy of the "Great American Dream." However, in an era of limits and shortages, the mass overbuilding of expectations is running on a collision course with those institutions who simply can't produce. The feelings of entitlement generated through raised expectations is leading people to take matters into their own hands. It is part of the "me first" syndrome mentioned earlier and may account for the self-fulfillment of expectations through shoplifting, embezzlement, and other antisocial acts. It also is leading to a complete distrust of our social institutions, especially government, and is resulting in more and more power groups making claims on whatever resources are available. Each of these power groups is clamoring for top priority and is using its weight and voice to claim essentiality.

The implications of this situation to the recreation profession are again perhaps best stated by Philip Lesly. In this setting of priorities and struggle for power, he believes: (1:6,7):

> The police forces will be maintained, fire protection will continue, the streets will be kept free of garbage and rats, the schools will be kept open, water will be pumped and the transit system will operate unless our society collapses. But as of now, the public does not see such a grim necessity for maintaining (public park and recreation) budgets or allocating gasoline and fuel oil to keep the parks and playgrounds open or enable people to reach them. Life without outdoor recreational facilities and music and libraries may become grim and heartless, but that is not as evident as how savage life will be if the forces are denied that now demand their exalted expectations be fulfilled.
>
> The result - - on the course we are now heading - - will be that the elements having little visible power or clear-cut value to society will not only be outpaced, but may be squeezed out of existence.

To bring a very current perspective to this issue, let me quote Amitai Etzioni, a professor of sociology at Columbia University and currently a senior advisor to the White House (2:54):

> America is in the midst of a grand dialogue. We are choosing between a reindustrialized society and one emphasizing quality of life, in which greater understanding of self, of relations to others, and more communing with nature are stressed.
>
> If we opt for quality of life, we will gradually lose our economic strength until in 10 or 15 years we're going to be like a South American country; we will become a "siesta society" in which there is less drive and less productivity. There are signs of this now. Our railroads, bridges, and highways are deteriorating and look ever more like those in Latin America.

> If we choose to reindustrialize, then we will be able to come to grips with our number 1 problem: the loss of productive capacity, which lies behind inflation, lack of adaptation to the energy problem and other ills.
>
> As things stand today, one of the weakest voices is that of public recreation and parks. It is becoming starkly clear that unless your group quickly establishes its essentiality, you face a grim spiral of decline. The human climate is rapidly turning against you and your capacity for influencing it is eroding. You may be running out of time to establish your your case while all around you others are shouting and making it harder for you to be heard.

There are many in the audience whose response might be - so what; let the private sector take over, they can do a better job!

My response to these reactions is that while I welcome more involvement by the private sector in the provision of recreation and believe strongly in private/public cooperation; I am not convinced that we can totally relegate all leisure services to private industry. It must be remembered that the prime objective of private enterprise is to make a profit, and like any other business, those products that don't sell are pulled from the shelves. Yet, it might be these very same products that are vital to an individual's leisure needs. Nevertheless, if we don't heed what Lesly says - if we don't learn how to deal with the human climate - then the only option that may be open to public recreation and park agencies is to turn everything, including research, over to the private sector.

These, then, are just a few of the major issues that I see confronting us. While most of the issues are with us today, the cyclical nature of life leads me to believe that such issues are trends that we can see increasing in importance over the next quarter of a century.

How will the recreation professional be able to cope? Let me close with some random thoughts:

1. The "me first" syndrome is not necessarily bad. Indeed, the striving towards individuality, if accompanied by leisure literacy, could lead to the ultimate goal of the recreation professional - to work himself out of a job. Such literacy will only come about, however, if the professional views his role more as a facilitator, enabler, and educator rather than simply a provider of opportunity.

2. The recreation professional must become more in tune with the social issues of the time and their implications for the provision of futu leisure services. In this light, such tasks as long-range planning must begin to take into acco not only the tangible factors, but also the intangible aspects of the human climate.

3. The recreation professional must begin now to justify his existence and essentiality in more human terms. This will involve, among other things, an evaluation and analysis of leisure services and leisure experiences relativ to their effect on the individual, and their effect on the economy, health, and productivity of society.

Finally, while it may appear that I've painted a picture of gloom, I don't want to appear as if all is lost. Indeed, such social trends may provide us with the opportunities to be the creative individuals we think we are. Less federal money may force us to be more creative in establishing linkages with the private sector. Less staff may force us to be more creative in using volunteers, a growing leisure experience for many people. Less facilities may force us to be more creative in identifying and using the unidentified public and private resources that exist in our communities.

LITERATURE CITED

Lesly, Philip. "The People Factor and the Crisis of Confidence," a presentation to the 1976 NRPA Congress, Dallas, Texas. 25 pp.

"A Conversation with Amitai Etzioni: Is the U.S. About to Become a 'Siesta Society'?", U.S. News and World Report, Vol. LXXXVIII, No. 14, April 14, 1980, p. 54.

OUTDOOR RECREATION TRENDS IN THE 1980'S SO WHAT? - IMPLICATIONS FOR SOCIETY![1]

Carlton S. Van Doren[2]

INTRODUCTION

My purpose today as the last speaker is twofold. I have been asked to summarize the many excellent presentations we have heard during the previous two days and to be a spokesman for society's viewpoint. It is my intent to challenge you. I hope to draw your attention to some implications concerning outdoor recreation trends in the 1980's that I foresee in this time of continuous societal change.

T. S. Eliot said, "The future has many cunning corners" and a traditional Japanese saying admonishes, "If you talk about the future, even the demons will laugh." In spite of these cautions concerning prognostication, the implications to society may really be, So What? Why? Because I have to question if our trends, based on data compiled in the 1970's, have really allowed us to recognize that we have moved into a new post-industrial era of leisure. I firmly believe that once in a while a look at events, attitudes, and philosophies of the past assist us to place the present in a better perspective. The intent is to develop a spirit of creativity and a sense of the past that will enable us to ponder the future.

The major question facing us today concerns our human attitudes toward work and leisure. In the words of philosopher Eric Hoffer, it is the "centrality of the human factor that makes industrial societies at present so unpredictable." Currently, we are riding a crest of a leisure/travel/recreation spending panic, an attitude of, do it now, because tomorrow we may not be able to! As individuals, we are uncertain as to what the future holds for us. Our society has mixed emotions about the future. This is understandable if you stop and think about the changes that have affected our lives in the last two decades. In the 1960's, we focused on genuine concerns for racial inequality, poverty, and environmental pollution. As we moved into the 1970's we were involved in a war in Southeast Asia with confused, mixed commitments and emotions. Our president at that time successfully disengaged us from this unwanted war and then proceeded to deceive us with an event called Watergate. To provide a capstone to our frustrations we then moved immediately into a national and worldwide energy crisis with its attendent, insidious monetary inflation. In addition, Third World changes are emotionally draining our society. It is difficult learning to cope with continual change.

These events, the "Future Shock" of Toffler, have caused us to momentarily lose our confidence, question the future, and have created a focus on the present. We made questionable progress in handling our problems of racial and sexual inequality, poverty, crime, and pollution. But our confidence in our social, economic and political institutions and in our expectations of a better quality of life are questionable. Society is regrouping. We are questioning whether our governmental institutions can really solve our problems or that people can influence government. At the same time we are frantically seeking to exploit our American dreams before we awaken to find some of them are no longer possible. We have shifted from an American trait of deferred gratification to almost panic consumption of goods and services. Some have called this instant consumption a new American ethic. Monetary savings, family stability, and conscientious work habits are not fostered by such "gusto" consumption and actions.

The March, 1980, issue of the Newsletter of the Texas Tourist Development Agency contained an interesting article about our conspicuous consumption. The newsletter related a study by the Barton, Durstine and Osborne Agency showing that Americans put vacations first on a list of ten luxury items. The luxury list with items in order of importance included: vacationing, dining in expensive restaurants, purchasing expensive cuts of meat, cosmetics, sporting equipment, household furnishings, alcoholic beverages, major appliances, clothes, and movies. Some of the trends in outdoor recreation discussed at this symposium support this survey.

Trends in the private sector of the recreation/travel/tourism industry also support the above priorities. The 80's are touted as the

---

[1] Paper presented at the National Outdoor Recreation Trends Symposium, Durham, NH, April 20-23, 1980.

[2] Professor, Recreation and Parks Department and Texas Agricultural Experiment Station, Texas A&M University, College Station, TX 77843.

"Travel Decade." Emergent life styles seem to favor recreational travel. Travel is considered a right, not just a privilege. The Big Picture, a major annual publication in the travel industry, states that in 1979 U.S. travelers spent $126 billion on trips to places 100 miles or more from home. This is more money than is spent for clothing, automobiles, and for national defense. Only food, housing and income taxes, according to The Big Picture, exceed travel expenditures.

Is our society on a leisure, recreation, travel binge because we do not have confidence in our future? Quite the contrary, we are consuming these goods and services because we see a retrenchment in the future and a necessity to change our habits, desires, and values. The implications for society in this new leisure era can best be described by a brief analysis of the eras of leisure/recreation during the last century. I am indebted to my faculty colleague at Texas A&M, Clare Gunn, for providing the initial effort in describing these eras.

This historical perspective is provided in Figure 1 in the form of what the Hudson Institute might describe as an "analytical summary." The four eras are entitled: High Society - 1860-1920; Mass Recreation - 1920-1958; Mass Mobility and Transcience - 1960-1974 and Post-Mobility Adjustment - 1974--. Each era has ten variables or elements that focus on the key events or philosophy of the period. These ten variables are Population Characteristics and Trends, Personal or Societal Philosophy, Time for Recreation, Income, Recreational Activities and Equipment, Political Actions, and Evolution, Public and Private Organization for Leisure, Advances in Technology and Communication, Mobility and Facilities and Services. A study of these four eras of leisure/recreation provide us with an enlightened historical perspective that assists our analysis of the present and casts some light on the near future.

Brevity forces me to concentrate on the present era, Post-Mobility Adjustment. This era was initiated by the first energy crisis in 1973-74 and its effect on the economies of the industrial world has been evolutionary and identifiable. An analysis of the variables currently evolving leads me to believe that some major and minor adjustments in society's leisure patterns can be suggested. The key variables that will have the largest impact in the short term are money (inflation) and mobility (energy). These two variables are intimately tied together and impact the remaining eight variables.

Population Characteristics and Movement

The population of the United States has increased by more than three times in the last 120 years. There is evidence that the population explosion of the post World War II years has leveled off. In 1978 our growth rate was less than one percent. This means that the population pyramid for the next decade can be analyzed with some degree of certainty. Our predominantly urban nation will grow older with the largest group in the middle aged brackets, between the ages of 25 to 45 years. This group may continue the same outdoor recreation habits pursued when they were younger, but it will be more affluent which may modify spending and travel habits. Persons in the older age brackets up to 65 years will increase by ten percent. They will also have more disposable income and with a continuation of early retirement, possibly more leisure time. The elderly over 65 years are projected to increase at twice the normal growth rate, as life spans increase. This group may be less affluent, but I believe we can project that a large number of these people will migrate to the Sun Belt if at all possible.

The Sun Belt's attraction is not only for retirement, but for economic advancement and opportunity. There is evidence that energy resource rich states in the Mountain West will share the Sun Belt growth. Wyoming today is an excellent example of energy inspired growth. Growth of this type will in some areas force society to express a choice between energy exploitation and natural resource preservation. In many cases, I predict energy will be the winner initially with a gradual shift by the 1990's to the preservation approach as we either develop new energy technology, change fuel sources or reduce our energy utilization.

The suburbs will continue a slow growth rate, but inhabitants may have to settle for fewer public social services as taxes are converted to use for essential services. Smaller communities in a rural setting will see some rebirth as a portion of our populace seeks a more conservative, frugal lifestyle. These communities will usually be in areas with distinct climatic and physiographic appeal, many adjacent to large public recreation areas.

Some of the center city population growth will continue where local leadership continues to organize with industry to accomplish major inner city restoration and reinvestment. Atlanta and Detroit may be two of the better examples of this process during the last decade.

Personal/Societal Philosophy

Our philosophy toward leisure, recreation, and travel has changed dramatically since the first High Society Era. Leisure activities are now considered a right for all, not just for the affluent upper class. The 1980's will continue as a period of growing self-actualization and improvement. The "me generation," as it grows older and matures, will constitute a very assertive and vocal public. As consumers, society in the

FIGURE 1.-- SIGNIFICANT EVENTS BY RECREATION/LEISURE/TRAVEL ERAS

VARIABLE	HIGH SOCIETY 1860-1920	MASS RECREATION 1920-1958	MASS MOBILITY - TRANSCIENCE 1958-1974	POST-MOBILITY ADJUSTMENT 1974 --
POPULATION CHARACTERISTICS TRENDS	Rural N.E.-Midwest 50 million People	Rural--Urban Suburbia-West Coast 130 million	Urban-Nucleated City-70-75% of Pop. Sun Belt Growth 200 million	Central City-Small Town Growth - Rural 242 million (1990)
PERSON/SOCIETAL PHILOSOPHY	Nuclear Large Fam. Puritanical Work-Ethic Self-Denial	Family-Smaller Leisure Recreation Emergent A Privilege To Enjoy Leisure	Single Parent Family Self Gratification - "Me" Generation Minority Actions Changing Role of Women-ERA	Leisure/Recreation-A right-Lifestyle Individual Awareness Self-Actualization Self-Improvement
TIME	60 hr.work week Sunday Free	50 hr.week Saturday Free Paid Vacation	40 hr.week 3-Day Weekends	38 hr.week "Moon lighting" Do it yourself home repairs
INCOME-MONEY	Hourly Wages	Salaries	High Disposable Income Era of Credit 2 Income Families	Inflation Zero Growth (?) Cost Consciousness Electronic Money
ACTIVITIES AND EQUIPMENT	Church Centered Bicycle,Golf,Tennis	Family Centered Improved Equipment Boats,Camping,Equip.etc.	Social Group Specialized Activity/Equip. ORV'S Back to Nature Movement	Electronic Games Human Energy Physical Fitness High Risk Sports
POLITICAL ACTION	Conservation/Preservation Leadership-Management of Natural Resources	Environment Management for Public Use	Reactionary Leadership Environmental Awareness-Ecological Ethics - Congestion In Parks	Public Involvement Leadership Localized Congestion
PUBLIC/PRIVATE ORGANIZATION	Professional Sports Public Recreation Movement City-National Parks, Amusement Parks	Amateur Sports State Parks TVA-C of E Regional Parks	Disneyland-Theme Parks Mission 66 Individualized Travel	Airline Deregulation Tourism Caucus Package Tours
TECHNOLOGY & COMMUNICATION	Photography Movies-Wireless Mass Production-Literature	Radio-Television Plastics-Super Alloys Air Conditioning Computers-Electronics	Instant Photography Satellite Communications Computer Management	Videophone Cottage Electronics
MOBILITY	Coal and Steam Railroad,Ship,Mass Tr.	Automobile Airplane,Small Group Tran.	Interstate Highways Rec.Vehicle,Sub-sonic Aircraft	Supersonic Travel ? Mass Transit ?
FACILITIES/ SERVICES	Luxury Hotel/Resorts Second Homes-Wealthy Overseas Travel	Motels Second Homes,Mid.Class	Private Campgrounds,Lodging Franchises,Fast Foods,Full Service Campgrounds	Family Camping,Time Sharing Cruise Ships,One Stop Vacations Family Camp.,Reserv.to enterparks

1980's will demand quality goods and experiences, including that portion of disposable income invested for leisure/recreation/travel. In some instances, "Nadarism" will manifest itself in our industry and be directed at both the public and private sectors.

There is a possibility that an assertive society will increase as the private sector continues to move to specific product differentiation and customization in order to market goods and services. As these submarkets gain in popularity for the middle and upper income levels of society, the less affluent will look to public resources to meet their demands. One maxim seems to hold true throughout all the eras of leisure/recreation/travel -- the consumption of the wealthy (yesterday's jet set) is constantly emulated by the masses in terms of activities and spatial location. As an example, I need only to remind you that thirty years ago, skiing, golf, and tennis were essentially rich men's sports and Miami Beach and Las Vegas became profitable resorts, initially, by spending from upper income groups.

Managers of public resources will continue to be pressured by consumers of the submarkets now being sold by the private sector. As an example, the Travel and Tourism Executive Newsletter (March, 1980), contained information on the backpacker submarket quoting an Adventure Travel Magazine study that the median age of backpackers is 33; income $28,000 per household; 89 percent are college educated; 60 percent are in managerial-professional occupations; and 62 percent own their own homes. They spend $2,300 and travel 35.8 days a year, averaging 6 trips. These are the wilderness buffs in our public parks and forests. Not all are this affluent, but an estimated 10 - 25 million hikers, if they decide to assert themselves, may be very effectual in bringing about their desired managerial changes.

In the past, the strongest influence on leisure participation has been the family. The family group will continue to exert a strong influence in the next decade; however, changes can be expected. Later marriages, fewer children, and single-parent households will bring about real shifts in recreation activities, and the times and locations of participation.

Time

During the first three eras, the work week was substantially reduced from 60 hours to 40 hours and the paid vacation became common. The work week in the future should remain at 38-40 hours with the introduction of Flex-time as described in Toffler's recent book, The Third Wave. Inflation will encourage mini-vacations and continued extended weekends of leisure activities. The shrinking value of the dollar may also encourage second jobs and more part-time employment as well, thus, for some in our society a reduction of leisure activities in an outdoor setting may be time prohibiting. With less leisure time, home recreational activities will increase.

Income

Our nation during the last decade may have reached a peak in the distribution of personal income. As we begin the 1980's, one word - - inflation - - immediately captures our individual interest and sometimes our anger. Disposable income has traditionally been a good indication of the amount of leisure expenditures and activities. The facts seem to be that this income is stable but probably declining. There are increasing conflicting signals of a "spend now" attitude offset by a "waste not" and frugality attitude. Nevertheless, there is an inertia in human society that dictates the continuation of spending habits to a point that the price is too high and the pocketbook is closed. Society, in some instances, is beginning to question the costs of goods and services. Hard choices are being made, discrimination in expenditures are evident and the quality of a purchase questioned. These are the implications for the 1980's.

Figure 2 provides a schematic overview of some economic indicators. The Travel Price Index, compiled by the U. S. Travel Data Center in February 1980, was 270.9 (1967=100). This was an increase of 25.1 percent since February 1979. The Travel Price Index (TPI) is a composite index consisting of the cost of food away from home, lodging, transportation and other goods and services purchased while away from home. The transportation component of this index includes air fares, inter-city train and bus fares, and the cost of gasoline. The Consumer Price Index of all items, after an increase equal to the TPI until mid-1979, indicated a reduced growth rate and only increased 14.1 percent between February 1979 and February 1980. The percentage of disposable personal income in the United States has shown a consistent decline from a high of 7.8 percent in 1973 to less than 5 percent in 1979. Real disposable income between 1967 and 1973 increased 17.5 percent, but between 1973 and 1979 growth was reduced to 5.5 percent. The implications of these indicators help to explain the mixed spending of society and the recent actions to curb credit in our electronic money era. The TPI is having, and will continue to have, a profound effect on leisure mobility.

One encouraging fact amid our struggle with domestic inflation is that the United States is a travel bargain for foreign visitors. If this continues in the 1980's, it does have implications for our most prominent public parks. We can expect increasing foreign visitors at sites in the vicinity of the major gateway cities such as New York City, Miami, Houston, Atlanta, San Francisco and Los Angeles.

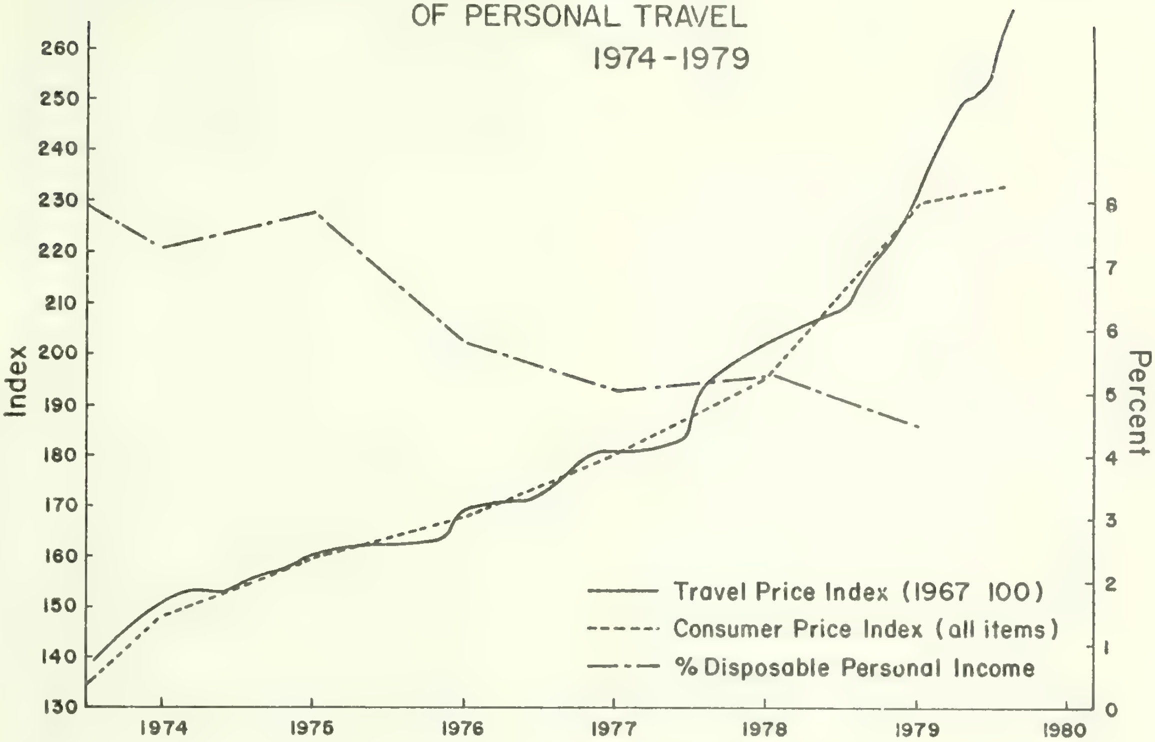
Activities and Equipment

President Carter's Federal Energy Conservation Plan, if initiated, is devised to reduce leisure travel and certain energy consumptive leisure activities. His proposal for a vehicle sticker plan restricting the days on which car drivers could purchase gasoline would have an obvious negative impact on recreation. Households would be forced to select weekend days for recreation which, in effect, could constitute a weekend gasoline ban. The proposal for a compressed work week could either negatively impact recreation activities or possibly encourage home centered activities. The proposed ban on the use of recreational boating seems unrealistic as a conservation measure and will probably not be implemented. The recreational boating industry has claimed that only one-half to 1 percent of all gasoline consumption is used by the recreational boater.

Inflation, energy cost, and energy availability will undoubtedly cause an evolutionary change in leisure activities and the use of equipment in the 1980's. There will be less driving for pleasure, and a continued focus on human energy leisure activities such as hiking, bicycling, cross-country skiing and sailing. According to the Michigan Department of Natural Resources, sailboats on Lake Michigan accounted for 26 percent of the transient boating population in 1973. In 1979 sailboats accounted for 52 percent of the population (Michigan Natural Resources Magazine, 1980). Eric Hoffer's statement that with "the exhaustion of raw materials and sources of energy, society will turn to creative energies of the people" may manifest itself in leisure pursuits. New sports such as wind surfing and wind skating may be examples and such high risk sports for some will be even more popular. It is very evident that backyard and close-to-home (local and regional) facilitie will receive more use pressure during the coming decade.

We can also expect to see more consumption of activities provided by the private sector and an increase in some activities supported by the public sector. Bowling may increase once again and theme parks will continue in popularity.

FIGURE 2. --SELECTED ECONOMIC INDICATORS OF PERSONAL TRAVEL 1974-1979



SOURCES: Travel Price Index from U.S. Travel Data Center, Washington, D.C.
Consumer Price Index - U.S. Bureau of Labor Statistics
Disposable Personal Income - Survey of Current Business

Shopping centers will increasingly become centers of both passive and active leisure pursuits. There will be pressure to increase public support for the cultural arts and handicrafts. The astute public recreation manager will be one who facilitates cooperation and coordination with the private sector. Leisure services on school property and on other public properties not previously utilized for leisure activities will increase in this decade.

The sale of expensive recreational equipment, such as recreation vehicles and boats will remain in a temporary slump. Sales can be expected to increase as smaller, more energy efficient equipment is marketed in a few years. For those currently owning recreation vehicles and outboard boats, the sunk cost of the past investment will either force a sale of the equipment at considerable loss of money or the use of the equipment will continue on a time sharing basis. Are we prepared for ORV's to come to our public facilities with not just one family, but possibly two or three families, with a desire to not only park the vehicle but pitch a tent or two on the site as well? In the Rio Grande valley of Texas, winter visitors are leaving their trailers or recreation vehicles in the valley this spring and are driving in small cars or flying back to northern homes.

Political Action

An assertive society has already forewarned us of the action that we can expect on the political front in the next decade. Special interest groups will grow stronger. Tax cutting at the state and local level, such as California's Proposition 13 and the current Jaws II, simply means that competition for public funds will increase. Some governments will consider recreation as non-essential. Financing and managing public facilities for leisure will have to come from new funding sources. More pay-as-you-go fees are on the horizon. A public park is not a free good any longer and I doubt if it ever really was such a good. Creativity, innovation, and compromise will be the key words to successful public recreation facility development and management. Lessons can be learned from the private sector in terms of efficiency, flexibility, automation, and public facility marketing. There should and probably will be more public and private cooperative development of recreation sites forced upon government by a demanding public.

Public/Private Organization

Coordination and cooperation between public and private institutions providing goods and services in leisure may be more prominent during this decade. Increased competition for the leisure dollar, rising costs, and public sentiment for quality experiences may foster much quasi-public organization.

Social-cultural constraints to planning are well documented and include definite time lag trade-offs with special interest groups and a past resistance to government control and regulation (Kaczka and Schleusner, 1980). The 80's should see decentralized government involvement in recreation with local leadership and public involvement. Organizations and institutions having direct appeal to society will be the ones that promote quality experiences, outstanding service, value, and satisfaction. Rising transportation costs will provide one avenue for public/private cooperation in local mass transit and for package tours in order to gain access to public recreation sites.

Technology and Communications

Our growth in technology and communication has been a mixed blessing to leisure. We are probably one of the most well-informed nations in the world. Mass communication has made us aware of the beauty of our country, of natural catastrophies, and of evolutionary events. Recently, we have all followed the eruption of Mt. St. Helens and some people in the northwest have endangered their lives and the lives of others by a desire for a closer look. The irony of our technology, particularly in the public sector, has been our inability to harness our resources to continuously monitor outdoor recreation activities. Our data collection procedures at best have been sporadic. In addition, technological growth seems to create new environmental problems that have a direct bearing on the natural resources of our recreation areas.

The next decade may fortunately bring with the financial belt tightening better data collection and hence better planning by the use of technology such as computer simulation. We may even witness increased social engineering through better public relations by public agencies and successful attempts to reduce peak period congestion by informing the public of alternative recreation sites.

There is little doubt that the consumer will become, as a result of better communications, very well informed and will increasingly scrutinize public and private policy decisions directly affecting his leisure time and expenditures. Comparison shopping for leisure experiences will result. Technology and communications will force the leisure service manager to maximize his revenue cost per visitor, whether in the public or private sector. The consumer likewi will evaluate his experiences in terms of both psychological satisfaction and economic outlay.

Mobility

Never, in the historical development of our leisure growth, has recreation system accessibility been a more important consideration as in the 1980's. A major implication for a society in pursuit of leisure experiences is, at this point, dependent upon where people live and the extent of their mobility. The immediate future of outdoor recreation trends depends upon our understanding of people's mobility and their space adjusting behavior.

In the United States, 81 to 84 percent of all our transportation is based on the automobile and truck. We have become dependent upon the automobile for both business and pleasure mobility and the cost of gasoline is considered paramount by many in society to individual and family health and well-being. The automobile is a symbol of our affluence or frugality and definitely of our individuality. When we are informed that the cost of gasoline increased 67.9 percent in 1979, we are a psychologically shaken and somewhat threatened society. We realize that fuel at subsidized prices has essentially been a free good and now the handout has been suddenly and somewhat brutall withdrawn. We are beginning to husband the second most expensive possession in a majority of families; the automobile. Some may even trade down to a smaller automobile to obtain fuel efficiency, being reluctant to lose mobility.

During the fuel shortage in the spring and summer of 1969, we looked to other methods of mobility. We turned to a dying mode, Amtrak, and filled trains to capacity. In the Northeast Corridor, where the passenger rail system was more efficient and developed, area gasoline consumption was 23 percent less per capita than anywhere in the Nation during the first half of 1979. Some chose the airplane and in spite of air fare increases of 33 percent between February 1979 and February 1980, there were 47 million air trips, during the fourth quarter of 1979. During this quarter, air transportation's share of total trave was 18 percent, the highest level for the year (U. S. Travel Data Center, April, 1980). Accordin to the U. S. Travel Data Center, more than one-hal of these air travelers were on vacation trips. It is little wonder that with aviation fuel selling for as much as 95 cents per gallon, compared to 35 cents in 1978, that this industry's fuel costs were more than 11 billion dollars in 1979. Alternative transport modes to the automobile may be a short term solution for us, but fuel price has become a major constraint to everyone's mobility. Mass transit will, of necessity, be more prominent in the future decade. Buses, for example, can claim 240 passenger miles to one gallon of fuel and operate for as little as 3 cents per mile.

The automobile costs upwards of 21 cents per mile and trains, 9 cents per mile.

The implications of the mobility variable include the increased use of recreation sites near residential areas, primary local and regional sites, car-pooling for leisure/vacation trips, longer stays at specific sites, and probably overt public policy to encourage mass transit to all sites.

Facilities and Services

The President of the Marriott Corporation recently stated that the $100 a night room was not very far off. It is obvious that the price of lodging will have an effect on the use of outdoor recreation areas. With commercial lodging very expensive, family travel in the 1980's will probably mean a substantial increase in camping. Campers in our parks and forests will want to settle in for long stays and they will want a variety of services that public facilities may not be providing at present. Some campers will opt for the commercial campground because it provides the amenities not found at a public site. These campers will still visit the public recreation area.

Second home construction in the vicinity of outdoor recreation areas will cease, if it has not already done so. The owners of these second homes, in order to maintain them, will probably resort to time-sharing arrangements with friends or relatives. Nearby recreation areas will consequently receive new visitors perhaps unfamiliar with our parks and forests.

Consumers are currently shopping for value during their weekend and vacation trips. They have discovered that the cruise is now one of the best values available. In the 1980's, the package tour which includes national public landmarks may also develop as a coveted consumer package. The implications of this development can be both positive and negative. On the positive side, by working with tour companies, public facility managers can schedule off-peak visitation. On the negative side, it means that package tours may continuously advance book the rooms in public hotels and lodges to the exclusion of regional and local inhabitants. In addition, the staff will have to be prepared to direct, handle, and control the package tour groups in a manner that provides a satisfying experience to them and without environmental detriment. As an example, the National Park Service is currently facing the package tour/environmental problem in Glacier Bay National Monument. A conflict exists between shiplines and the Service over a proposed limit to the number of cruise ships to visit the Bay. The Service is setting a maximum of 95 cruise calls in 1980 to protect the feeding habits of the humpback whales (Travel Weekly, March, 1980).

CONCLUSIONS

We are at a critical period in the historical development of leisure, recreation, and travel. Inflation and limited mobility will force evolutionary changes in leisure time life-styles in the next decade. Our society will be slow to accept our national and individual limits on leisure activities. We as planners, managers, and scholars must become more adept at reading the pulse of the population. This may be easier to do than we realize as consumerism, activism, and individualism will be a common phenomena. From the private sector we must learn marketing research.

Continuous change is a part of our society. Recognizing and adopting outdoor recreation programs and budgets will require creativity, imagination, and innovation in a society where changing conditions will accelerate. The demassification of Toffler's Third World will be moderate, but will lead to decentralization and regionalism in governmental programs. Public expenditure for recreation and leisure will be reduced. In some locales society may successfully force an increase in some leisure expenditures and be willing to accept less public services in another area. Pay-as-you-go public recreation will be common by the 1990's.

We will all recreate closer to home, partake more of privately provided recreation services near home, and demand quality services and facilities. The long distance family vacation will become a major event in the family's life cycle. In a way we will return to some of the characteristics of the first Era of Leisure - High Society as only the wealthy will enjoy the mobility abandonment which most of society experienced during Mass Leisure.

In closing, I would like to leave you with some principles of forecasting that include the bitter and the sweet as a reminder not to take ourselves too seriously. The critical factors for successful forecasting are:

1. Identify and publicize the assumptions behind your forecasts - they are all the excuse you will need next year.

2. Long-range forecasts provide more job security than short-range forecasts.

3. If you cannot forecast accurately - forecast often.

4. If you forecast turns out to be correct, never let them forget it.

5. Remember the famous words of wisdom of that Oriental philosopher who said, "He who lives with crystal ball better learn to eat ground glass."

LITERATURE CITED

Baum, H.S. 1977. Toward a post-industrial planning theory. Pol. Sci. 8:401-421.

Fishman, J. A. 1979. Outdoors in the 80's: Acceleration but a shift in direction. N. Y. Times. Dec. 31.

Jennings, L. 1979. Future fun: Tomorrow's sports and games. Futurist. Dec. p. 417-431.

Hoffer, E. 1979. Beware the intellectual. Sat. R. Nov. 24.

Kaczka, E. E. and D. Schleusner 1980. Tourism planning and the use of computer simulation: Nantucket Island, a case study. J. L. Sciences. 3(1):62.

Kahn, H. 1979. Leading futurologist traces next half century in travel. Travel Trade, News Edition, Sect. 1. 96(6). Jan. 31.

Kahn, H. and J. B. Phelps 1979. The economic present and future: A chartbook for the decades ahead. Futurist. June. p. 202-222.

Kennedy, E. 1979. The looming 80's. N. Y. Times Mag. Dec. 2. p. 68-9, and 110-120.

Kopta, K. 1980. Saving the humpback: A tale of conflict between shipping interests and Uncle Sam. Travel Wkly - The Month in Review. Mar. p. 19.

Lazer, W. 1978. The 1980's and beyond: A perspective. ICTA: Marketing for travel agents. p. 49-58.

Levy-Pascal, E. 1979. Will the rising price of energy push us over the cliff? Futurist. Dec. p. 477.

O'Toole, J. 1976. Energy and social change. MIT Press, Boston.

Papson, S. 1979. Tourism - world's biggest industry in the twenty-first century? Futurist. Aug. p. 249-257.

Power, J. E. 1979. The markets of affluence. Resort Mgmt. Dec.

Robinson, I. 1980. Irwin Robinson's viewpoint. Travel Wkly. 39(6).

Sails increase on our big lakes 1980. Mich. Nat. Res. Mag. 49(3):4.

Sutton, H. 1980. 80's traveler: his life and future times. Sat. R. Jan. 5. p. 20-24.

Texas Tourist Development Agency (Newsletter). 1980. 13(7).

The fall and rise of U. S. frugality 1980. Time. Mar. 3. p. 84.

The shrinking standard of living 1980. Bus. W. Jan. 28.

Toffler, A. 1980. The third wave. William Morrow, New York.

Travel and tourism executive newsletter 1980. Feb. 1(9).

Travel market yearbook 1980. 1980. Ziff-Davis Publ. Co., New York.

1980 economic survey of the travel industry. 1980. Travel Wkly. 39(8).

U. S. Department of Commerce, Industry and Trade Adminsitration 1979. The growth of selected leisure industries. U.S. Gov. Print. Off. Washington, D.C.

U. S. Department of the Interior, Heritage Conservation and Recreation Service 1978. 1978 nationwide outdoor recreation plan, task force report. U. S. Gov. Print. Off. Washington, D.C.

U. S. News & World Report 1979. Challenges of the 80's (32 page special selection). U. S. News & World Report, Inc. New York. Oct. 15.

U. S. Travel Data Center and Travel Research Association 1980. Proceedings: 1980 travel outlook forum. Washington, D.C.

U. S. Travel Data Center 1980. Travel printout. Monthly issues Jan. 1974 - April 1980. Washington, D.C.

Waters, S. R. 1980. The big picture, travel 79-80 world trends and markets. ASTA Travel News. New York.

NATIONAL OUTDOOR RECREATION TRENDS SYMPOSIUM REGISTRANTS

APRIL 20-23, 1980

Sherman Adams, President
Loon Mountain Recreation Corp.
Lincoln, NH 03251

Mark Anderson
Motorcycle Industry Council, Inc.
1001 Connecticut Ave., NW
Washington, D.C. 20036

Peter C. Anderson, Vice President
The Bank
Manchester, NH 03105

George Atkinson
Assistant Professor
Recreation & Leisure Studies
Northeastern University
Boston, MA 02115

Wes Bartlett
Associate Economist
Office of Parks & Recreation
Albany, NY 12238

Malcolm I. Bevins
Professor
Agr. & Resource Economics
University of Vermont
Burlington, VT 05401

Glyn Bissix
Coordinator of Outdoor Recreation
Nova Scotia Dept. of Culture,
Recreation and Fitness
Halifax, Nova Scotia B3J2V2

Robert Boston
Forester - Recreation Management
USDA Forest Service
Washington, D.C. 20013

James R. Branch, President
Sno-engineering, Inc.
Box 65
Franconia, NH 03580

Marie-Anne Brochu
Graduate Student
78 York Street
Welland, Ontario

John Brooks
East Lake Road
c/o Malcolm Allen
Homer, NY 13077

Chris Brown, Planner
Appalachian Trail Project
National Park Service
Harpers Ferry, WV 25425

John A. Brown, President
John Brown Associates, Inc.
Boston, MA 02109

Tommy L. Brown, Senior Res. Associate
Dept. of Natural Resources
Cornell University
Ithaca, NY 14853

Warren Brown
Heritage Conservation & Recreation
Service
U.S. Dept. of the Interior
Washington, D.C. 20243

James A. Bunce
Consultant - Michigan Travel Bureau
P.O. Box 30226
Lansing, MI 48906

William Burch
School of Forestry
Yale University
New Haven, CT 06511

Richard L. Bury
Professor, Dept. of Recreation
and Parks
Texas A&M University
College Station, TX 77843

Joseph Cardenuto
Park and Recreation Specialist
Penn State University
University Park, PA 16802

Roger W. Caves
Renewable Resources Planner
85 W. Park Place
Newark, DE 19711

David Chase
Associate Professor of Recreation
267 Rec. Building
University Park, PA 16802

Charles W. Christy
NH Division of Parks
Concord, NH 03301

Thomas Cieslinski
Recreation Planner
Maine Bureau of Parks &
Recreation
Augusta, ME 04333

Gerald L. Cole
Associate Professor
Dept. of Agriculture &
Food Economics
University of Delaware
Newark, DE 19711

Paula Cormier
Mathematical Statistician
Indicators of Outdoor Recreation
Trends
USDA Forest Service
Durham, NH 03824

Thomas M. Corsi
Assistant Professor
College of Business &
Management
University of Maryland
College Park, MD 20742

Rick Curtis, Acting Director
Recreation Planning Branch
Recreation Development Division
Alberta Recreation & Parks
10363 - 108 St.
Edmonton, Alberta
Canada

Hugh C. Davis, Director
The Environmental Institute
University of Massachusetts
Amherst, MA 01054

Chad Dawson, Research Associate
Dept. of Natural Resources
Cornell University
Ithaca, NY 14853

Paul Doherty, Director
Parks and Recreation
Dept. of Resources & Economic
Development
Concord, NH 03301

Ronald Dorsey
Recreation Specialist
Rm. 2340, 18th & C St.
Washington, D.C. 20240

Kent Dover
New Hampshire AAA
Manchester, NH 03101

B. Allen Dunn, Associate Professor
Department of Forestry
Clemson University
Clemson, SC 29631

Herbert E. Echelberger
Research Forester
Indicators of Outdoor Recreation
Trends
USDA Forest Service
P.O. Box 640
Durham, NH 03824

Arlin Epperson
1003 S. Eastwood Circle
Columbia, MO 65201

David L. Erickson
Assistant Professor
Dept. of Forestry
University of Kentucky
Lexington, KY 40546

Craig Evans
Heritage Conservation & Recreation
Service
U.S. Department of the Interior
Washington, D.C. 20243

* Alan Everson
Associate Professor
School of Forestry, Fisheries &
Wildlife
University of Missouri
Columbia, MO 65211

Kurt Fanstill
Supervisor - Planning Unit
Dept. of Natural Resources
Atlanta, GA 30334

Jane M. Farrell
Senior Recreation Planner
161 Franklin Corner Road
Lawrenceville, NJ 08648

James R. Fazio
Department Head
Dept. of Wildland Rec. Management
University of Idaho
Moscow, ID 83843

Roy Feuchter, Director
Recreation Management
USDA Forest Service
Washington, D.C. 20250

* Larry Forcier
Assistant Director
School of Natural Resources
University of Vermont
Burlington, VT 05405

Wayne Freed
Outdoor Recreation Planner
Corps of Engineers
Philadelphia, PA 19106

David T. Funk
Assistant Director for
Research
Northeastern Forest Experiment
Station
USDA Forest Service
Durham, NH 03824

A. H. Gilbert
Associate Professor
University of Vermont
Burlington, VT 05401

Geoffrey Godbey, Professor
Recreation and Parks
Penn State University
University Park, PA 16802

Charles R. Goeldner, Director
Business Research Division
Campus Box 420
University of Colorado
Boulder, CO 80309

Robert Graham
Assistant Professor
Department of Recreation
University of Waterloo
Waterloo, Ontario
Canada N2L3G1

Miklos Gratzer, Professor
SUNY, College of Environmental
Science & Forestry
Syracuse, NY 13210

Robert D. Greenleaf
Assistant Professor
Recreation and Parks Department
University of New Hampshire
Durham, NH 03824

Sheree L. Guthrie
204 Alcan Drive
Pittsburgh, PA 15239

William Hagdorn
Bureau Chief
Comprehensive Planning
Idaho State Parks & Recreation
Department
Boise, ID 83720

Robert J. Halstenrud, Manager
Developmental Syndicated Surveys
A. C. Nielsen Company
Northbrook, IL 60062

George T. Hamilton, President
The Bank
Concord, NH 03301

* G. A. Harrison
Professor of Recreation
Springfield College
Springfield, MA 01109

Milton Harvey
Professor of Geography
Dept. of Geography
Kent State University
Kent, OH 44224

Sherman S. Hasbrouck
Environmental Specialist
Land and Water Resources Center
University of Maine
Orono, ME 04469

Jeffrey M. Hirsch
Owner - Manager
Campers Inn, Inc.
550 Amherst Street
Nashua, NH 03063

Kenneth J. Hock
Associate Professor
Agricultural Economics
West Virginia University
Morgantown, WV 26506

Bob Hoddeson
New Hampshire AAA
Manchester, NH 03101

Kenneth Hornback, Chief
Statistical Office
USDI National Park Service
Denver Service Center
655 Parfet Street
Denver, CO 80225

Roger D. Hubbell, Chief
Office of Outdoor Rec. Services
Bldg (E), 2nd Fl., Fountain Sq.
Columbus, OH 43224

Lloyd Irland, Director
Bureau of Public Lands
Department of Conservation
State House
Augusta, ME 04330

Earl R. Jette
Executive Director
Dartmouth Outing Club
Hanover, NH 03755

William T. Jobe
Executive Vice President
International Snowmobile
Industry Association
Suite 850 South
1800 M St., N.W.
Washington, D.C. 20036

Steven P. Johnson
Associate Director
Minnesota-Wisconsin Boundary
Area Commission
Hudson, WI 54016

Frederick Kacprzynski
Recreation Planner
Federal Building
Laconia, NH 03246

Timothy B. Knopp
Associate Professor
College of Forestry
University of Minnesota
St. Paul, MN 55108

D. M. Knudson
Faculty
Forestry Department
Purdue University
W. Lafayette, IN 47907

A. Robert Koch, Chairman
Dept. of Agricultural Economics
Cook College
Rutgers University
New Brunswick, NJ 08903

Jim Kosuik
Park Ranger/Manager
Corps of Engineers
Franklin, NH 03235

Marvin Kottke, Professor
Dept. of Agricultural Economics
University of Connecticut
Storrs, CT 06268

David A. Kruger
Division Staff Specialist
Dept. of Game, Fish & Parks
Division of Parks & Recreation
Pierre, SD 57501

Fred R. Kuss
Associate Professor
Dept. of Parks & Recreation
University of Maryland
College Park, MD 20740

Roger A. Lancaster
Director of Research
National Recreation and Parks Assn.
1601 Kent Street
Arlington, VA 22209

Wilbur F. LaPage
Social Scientist
Indicators of Outdoor Recreation
Trends
USDA Forest Service
P.O. Box 640
Durham, NH 03824

Mike Lazarowich
Assistant Professor
Urban & Regional Planning
University of Waterloo
Waterloo, Ontario

Darrell E. Lewis, Chief
Division of Recreation
Bureau of Land Management
U.S. Department of the Interior
Washington, D.C. 20240

David W. Lime
Research Social Scientist
USDA Forest Service
1992 Folwell Ave.
St. Paul, MN 55108

John J. Lindsay
Associate Professor
School of Natural Resources
University of Vermont
Burlington, VT 05401

David Linton
Supervisory Editor
USDA Forest Service
370 Reed Road
Broomall, PA 19008

James R. Lyons
Program Analyst
Division of Program Plans
U.S. Fish & Wildlife Service
Washington, D.C. 20240

Thomas C. Mack
Marine Recreation Agent
University of Minnesota
Duluth, MN 55801

Marie Magleby, Instructor
Dept. Recreation & Leisure
Studies
Northeastern University
Boston, MA 02115

Edward Mahoney
Dept. of Landscape Architecture
& Regional Planning
University of Massachusetts
Amherst, MA 01002

* William F. Malcolm
Chief Planner
Sno-engineering, Inc.
Franconia, NH 03580

Robert E. Manning
Assistant Professor
School of Natural Resources
University of Vermont
Burlington, VT 05401

Albert J. Marmo, Chief
Policy Planning & Information
Analysis Staff
U.S. Coast Guard
G-BP
2100 Second St., SW
Washington, D.C. 20593

Jay D. Martindale
Resource Planner
Missouri Dept. of Natural Resources
Jefferson City, MO 65101

Bruce Matthews
Extension Specialist
State 4-H Office - UNH
Durham, NH 03824

Gina McLellan
Visiting Assistant Professor
Dept. of Recreation & Park Admin.
Clemson University
Clemson, SC 29631

Robert W. McLellan, Professor
Dept. of Recreation & Park Admin.
Clemson University
Clemson, SC 29631

George H. Moeller
Recreation Research
USDA Forest Service
Washington, D.C. 20250

Weldon J. Montgomery, Unit Leader
Land Use & Recreation
Michigan Dept. of Natural Resources
Forest Management Division
5th Floor Stevens T. Mason Bldg.
Box 30028
Lansing, MI 48909

Tal Morash, Professor
California State University
Northridge, CA 91330

Richard B. Morrison
Associate Professor
Northeastern University
Boston, MA 02115

Karl F. Munson
Graduate Coordinator
University of Maryland
College Park, MD 20740

Floyd L. Newby
Associate Professor
Forest Resources
University of Maine
Orono, ME 04473

Garrell E. Nicholes, President
The People Planners
Salt Lake City, UT 84117

Robert W. Norton, Director
Community Development
Everett, MA 02149

Greta O'Keefe
Midwest Research Institute
Kansas City, MO 64110

Joseph T. O'Leary
Associate Professor
Dept. of Forestry & Natural Res.
Purdue University
W. Lafayette, IN 47907

Robert Olson, Supervisor
Data and Analysis Staff
Recreation Resources Program
Tennessee Valley Authority
Norris, TN 37828

George Orning, Director
Research & Policy Section
Dept. of Natural Resources
Centennial Office Bldg.
St. Paul, MN 55155

Elizabeth Owen
Heritage Conservation and
Recreation Service
U.S. Dept. of the Interior
Washington, D.C. 20243

Earl Patric
Associate Director, RIAES
113 Woodward Hall
University of Rhode Island
Kingston, RI 02881

John Peine
Heritage Conservation and
Recreation Service
U.S. Dept. of the Interior
Ann Arbor, MI 48106

George Peterson, Professor
Northwestern University
Evanston, IL 60204

Steve Peterson
Director of Marketing
P.O. Box 30558
Billings, MT 59101

Robert L. Prausa
Recreation Group Leader
USDA Forest Service
633 W. Wisconsin Ave.
Milwaukee, WI 53203

George Plumb, Chief
Parks & Recreation Services
Forests, Parks & Recreation
Montpelier, VT 05602

Harriet Plumley
Research Landscape Architect
USDA Forest Service
P.O. Box 640
Durham, NH 03824

Linda Profaizer, Publisher
Woodall's Campground Directory
Highland Park, IL 60035

Dennis B. Propst
Outdoor Recreation Planner (ERD)
U.S.A.E. Waterways Exp. Station
P.O. Box 631
Vicksburg, MS 39180

Joseph F. Quinn
NH Division of Parks
Concord, NH 03301

Richard Ragatz, President
Richard L. Ragatz Associates, Inc.
Eugene, OR 97405

Carl Reidel, Director
Environmental Program
University of Vermont
Burlington, VT 05401

Robert W. Reinhardt
Senior Natural Resource Planner
Office of Parks & Recreation
Albany, NY 12238

Dan Ring, Student
Parks & Recreation
Rt. 1, Box 417
Albert Lea, MN 56007

Edward S. Rizzotto
Regional Recreation Resource Specialist
Dept. of Environmental Protection
Middlebury, CT 06762

Kathryn Rottmann
Park Resource Specialist
6 Sheep Pasture Lane
Huntington, NY 11743

Thomas Rumpf
Research Associate
Maine Forest Service
State House
Augusta, ME 04333

David Sanderson
Executive Director
New England Trail Rider Assn.
West Newbury, MA 01985

Vince Scardino
ABT Associates
Cambridge, MA 02138

Donald Schink
Recreation Resources Center
1815 University Ave.
Madison, WI 53706

B. J. Schruender
Multiple Use Planner
Dept. of Conservation
Augusta, ME 04333

Josef Schwalbe
ABT Associates
Cambridge, MA 02138

Mahmood Seyala
Associate Professor
University of District of Columbia
1331 H Street, NW
Washington, D.C. 20005

Noel K. Sheldon
Supervisory Forester
USDA Forest Service
Portsmouth, NH 03801

J. William Shiner
Professor of Parks & Recreation
Dept. of Parks & Recreation
Slippery Rock State College
Slippery Rock, PA 16057

George H. Siehl
Analyst in Environmental Policy
Environmental Policy Division
Congressional Research Service
Library of Congress
Washington, D.C. 20540

Judy Silverberg
NH Division of Parks
Concord, NH 03301

Paul Skydt, Head
Resource Assessment & Management
Alberta Recreation & Parks
10363 - 108 St.
Edmonton, Alberta
Canada

Robert Slagle, Forester
127 Highland Street
Plymouth, NH 03264

Charles K. Smith
Park Planner
Metropolitan Council
St. Paul, MN 55101

Stephen L. J. Smith
Assistant Professor
Dept. of Recreation
University of Waterloo
Waterloo, Ontario

Edward L. Spencer
Chief, Park Planning
Adirondack Park Agency
Ray Brook, NY 12977

Richard W. Stammer
Dept. Agr. Economics & Marketing
Cook College
Rutgers University
New Brunswick, NJ 08903

Barbara D. Steffen
Research Assistant
Box 24136 SW
Washington, D.C. 20024

David R. Stidham
Outdoor Recreation Planner
U.S. Corps of Engineers
Nashville, TN 37072

John M. Stokes
Chief, Lands & Waters
Iowa Conservation Commission
Des Moines, IA 50319

Daniel J. Stynes
Assistant Professor
Dept. of Park & Rec. Resources
Michigan State University
East Lansing, MI 48823

Chris Terry
Outdoor Recreation Planner
Dept. of Natural Resources
Indianapolis, IN 96204

Elizabeth Titus
Planner
Heritage Conservation and Rec.
Service
U.S. Dept. of the Interior
Philadelphia, PA 19106

Carlton S. Van Doren
Dept. of Recreation & Parks
Texas A&M University
College Station, TX 77843

Terry Vibeto, Planner
Box 139 - RR 2
Mandan, ND 58554

Donald A. Warman, Leader
Recreation Planning Group
USDA Forest Service
Portland, OR 97208

William S. Warner
Graduate Student, UMO
School of Forest Resources
University of Maine
Orono, ME 04469

Louellen Wasson
Home Economist
County Extension Service
University of Vermont
Essex Jct., VT 05452

Robert G. White
Research Assistant
Dept. of Forestry & Outdoor Rec.
Utah State University
Logan, UT 84322

Bruce Wilkins
Associate Professor
Cornell University
Ithaca, NY 14853

Ralph C. Wilson
Chief Recreation Specialist
Soil Conservation Service
U.S. Department of Agriculture
Washington, D.C. 20013

Thomas J. Wood, Director
Lake Superior Basin Studies Center
University of Minnesota, Duluth
Duluth, MN 55812

Dana Reed Younger
Outdoor Recreation Planner
Heritage Conservation and
  Recreation Service
U.S. Dept. of the Interior
Washington, D.C. 20243

Gus Zaso
Associate Professor
Recreation and Parks
University of New Hampshire
Durham, NH 03824

* cancelled

U.S. GOVERNMENT PRINTING OFFICE: 1980 611 071 552

LaPage, Wilbur F., Chairman
1980. Proceedings 1980 National Outdoor Recreation Trends Symposium. Northeast. For. Exp. Stn., Broomall, Pa.
(USDA For. Serv. Gen. Tech. Rep. NE-57)

Proceedings (in two volumes) of a national symposium on recreation trends held at Durham, N.H. on April 20-23, 1980. Volume 1 contains papers on trends in selected recreation activities and in recreation planning, policy, financing, equipment, organizational membership, lands and waters. Volume 2 includes papers on industry sources of trend data, applied trend research, the use of trend data for planning, and trend measurement.

907.2

Headquarters of the Northeastern Forest Experiment Station are in Broomall, Pa. Field laboratories and research units are maintained at:

- Amherst, Massachusetts, in cooperation with the University of Massachusetts.
- Beltsville, Maryland.
- Berea, Kentucky, in cooperation with Berea College.
- Burlington, Vermont, in cooperation with the University of Vermont.
- Delaware, Ohio.
- Durham, New Hampshire, in cooperation with the University of New Hampshire.
- Hamden, Connecticut, in cooperation with Yale University.
- Kingston, Pennsylvania.
- Morgantown, West Virginia, in cooperation with West Virginia University, Morgantown.
- Orono, Maine, in cooperation with the University of Maine, Orono.
- Parsons, West Virginia.
- Princeton, West Virginia.
- Syracuse, New York, in cooperation with the State University of New York College of Environmental Sciences and Forestry at Syracuse University, Syracuse.
- University Park, Pennsylvania, in cooperation with the Pennsylvania State University.
- Warren, Pennsylvania.

ODC 945.4(048.1)

GOVT. DOCUMENTS
DEPOSITORY ITEM

SEP 3 1980

CLEMSON
LIBRARY

PUBLICATIONS of the NORTHEASTERN FOREST EXPERIMENT STATION
1966-1976

CLEMSON UNIVERSITY LIBRARY
SEP 8 1980
SCI. TECH. & AGR. DIV.

FOREST SERVICE GENERAL TECHNICAL REPORT NE-58
1980

FOREST SERVICE, U. S. DEPARTMENT OF AGRICULTURE
NORTHEASTERN FOREST EXPERIMENT STATION
370 REED ROAD, BROOMALL, PA. 19008

Compiled by
Sylvia Horowitz
and Mary DeFusco

The Compilers

SYLVIA HOROWITZ and MARY DeFUSCO are respectively editorial assistant and manuscript typist in the Publication Services Group of the Northeastern Forest Experiment Station, Broomall, Pa.

MANUSCRIPT RECEIVED FOR PUBLICATION 14 APRIL 1979

INTRODUCTION

THIS LIST OF PUBLICATIONS was compiled as reference material for the forester, forestry researcher, and forestry student in particular and for other agencies and individuals who have concerns for forestry and conservation in general. It contains references to more than 2,000 publications by staff members of the Northeastern Forest Experiment Station and their cooperators during the 11-year period 1966-76.

Earlier publications of the Northeastern Station—and of its predecessor, the Allegheny Forest Experiment Station from its establishment in 1923—were listed in Northeastern Forest Experiment Station Paper 33 (1950) and USDA Forest Service Research Paper NE-62 (1967).

The Author Index at the back of the book includes junior authors as well as senior authors, listed alphabetically, and referenced to the numbers in the publications list.

AVAILABILITY OF PUBLICATIONS

Many of the publications listed here are now out of print, but copies may usually be consulted in public or university libraries maintaining government publications. Communicate with the library concerning the publications you need before making a trip.

A xerographic copy of publications in the Library's collection may be purchased from the National Agricultural Library, U.S. Department of Agriculture, Beltsville, Maryland 20705. The Library's order form, available upon request, should be used in ordering. All charges are payable in advance. Credit may be extended Government agencies and institutions upon request. Payments should be made by check or money order payable to the "National Agricultural Library." Currency is sent at the sender's risk. Payment for orders originating outside the United States should be made by international money order, or by draft on a bank in the United States. National Agricultural Library coupons (obtainable from the Library at $1.00 each) and UNESCO book coupons are acceptable. Microfilm: $1.00 for each 30 pages or fraction thereof from a single article or book. Xerox: 1-10 pages for $1.00; rates are based on per article.

Station publications for 1975 and 1976 are available from Publications Distribution, Northeastern Forest Experiment Station, 370 Reed Road, Broomall, PA 19008. Some earlier Station publications may be purchased from the National Technical Information Service. Consult the Distribution Officer at the Northeastern Forest Experiment Station for information about the availability of Station publications.

PUBLICATIONS

1. Adams, E. L.
1970. **How much can you afford to pay for hardwood logs? SOLVE will tell you.** North. Logger 19(3):18-19,39.

2. Adams, Edward L.
1971. **Effect of moisture loss on red oak sawlog weight.** USDA For. Serv. Res. Note NE-133. 4 p.

3. Adams, Edward L.
1971. **Instructions for using the SOLVE use packet.** USDA For. Serv. Northeast. Area, State and Priv. For. 20 p.

4. Adams, Edward L.
1972. **SOLVE: A computer program for determining the maximum value of hardwood sawlogs.** USDA For. Serv. Res. Pap. NE-229. 54 p.

5. Adams, Edward L.
1976. **The adjusting factor method for weight-scaling truckloads of mixed hardwood sawlogs.** USDA For. Serv. Res. Pap. NE-344. 7 p.

6. Alicandri, James F.
1966. **Locomotion of forest vehicles.** *In* Forest engineering symp. proc. W. Va. Univ. Tech. Bull. 82. p. 56-63.

7. Allen, Rufus H., Jr., and Willie R. Curtis.
1975. **A photographic technique for monitoring erosion on strip mined lands.** Photogr. Appl. in Sci., Tech. and Med. 10(4):29-31.

8. Allen, Rufus, H., Jr., and David A. Marquis.
1970. **Effect of thinning on height and diameter growth of oak and yellow-poplar saplings.** USDA For. Serv. Res. Pap. NE-173. 11p.

9. Allen, Rufus H., Jr., and William T. Plass.
1975. **Influence of fertilizer on survival of shrub lespedeza planted on acid spoils.** Tree Plant. Notes 26(4):12-13,24.

10. Allison, Richard C.
1971. **Utilization of oak residues.** *In* Oak symp. proc. USDA For. Serv. Northeast. For. Exp. Stn. p. 111-117.

11. Amman, Gene D., and Robert L. Talerico.
1967. **Symptoms of infestation by the balsam wooly aphid displayed by Fraser fir and bracted balsam fir.** USDA For. Serv. Res. Note SE-85. 7 p.

12. Anderson, R. Bruce,
1971. **Southern furniture manufacturers increasing in-plant production of dimension stock.** Woodworking & Furniture Dig. 73(3):30-32.

13. Anderson, R. Bruce.
1973. **Factors influencing the selection of state office furniture.** USDA For. Serv. Res. Pap. NE-266. 6 p.

14. Anderson, R. Bruce,
1976. **Factors influencing selection of office furniture by corporations and universities.** USDA For. Serv. Res. Pap. NE-343. 5 p.

15. Anderson, R. Bruce, and William C. Miller.
1973. **Wooden beverage cases cause little damage to bottle caps.** USDA For. Serv. Res. Note NE-161. 4 p.

16. Anderson, R. Bruce, and Paul E. Sendak.
1972. **Use of hardwood dimension stock by the southern furniture industry.** USDA For. Serv. Res. Pap. NE-225. 27p.

17. Andresen, John W.
1976. **Selection of trees for endurance of high temperatures and artificial lights in urban areas.** *In* Better trees for metropolitan landscapes symp. proc. USDA For. Serv. Gen. Tech. Rep. NE-22. p. 67-75.

18. Anspach, John C.
1975. **Current management practices on the Bethlehem Municipal Watersheds.** *In* Municipal watershed management symp. proc. USDA For. Serv. Gen. Tech. Rep. NE-13. p. 98-104.

19. Araman, Philip A.
1973. **A new kind of end-glued joint for the hardwood industry.** USDA For. Serv. Res. Note NE-156. 4 p.

20. Araman, Philip A.
1975. **Program SIRSP: An inventory control simulation program for the STUB (Short Temporarily Upgraded Boards) rough mill concept.** M.S. thesis. Va. Polytech. Inst. and State Univ., Blacksburg. 146 p.

21. Araman, Philip A., and Edwin L. Lucas.
1975. **An automated rough mill for the production of interior furniture parts.** USDA For. Serv. Res. Pap. NE-335. 5 p.

22. Armson, K. A.
1973. **Soil and plant analysis techniques as diagnostic criteria for evaluating fertilizer needs and treatment response.** *In* Forest fertilization symp. proc. USDA For. Serv. Gen. Tech. Rep. NE-3. p. 155-166.

23. Arner, Stanford L.
1974. **PROFILE—a computer program for displaying the geometric relationships of the responses in a factorial design.** USDA For. Serv. Res. Pap. NE-288. 21 p.

24. Aubertin, G. M.
1971. **Nature and extent of macropores in forest soils and their influence on subsurface water movement.** USDA For. Serv. Res. Pap. NE-192. 33 p.

25. Aubertin, G. M.
[1974] **Problems and techniques in sampling water for analysis.** Univ. Ky. Symp. on Use of Small Watersheds in Determining Eff. of For. Land Use on Water Qual. Proc. 1973. p. 1-9.

26. Aubertin, Gerald M.
1969. **An improved technique for taking hydraulic conductivity cores from forest soils.** USDA For. Serv. Res. Note NE-92. 4 p

27. Aubertin, G. M., and J. H. Patric.
1972. **Quality water from clearcut forest land?** North. Logger 20(8):14-15,22-23.

28. Aubertin, G. M., and J. H. Patric.
1974. **Water quality after clearcutting a small watershed in West Virginia.** J. Environ. Qual. 3:243-249.

29. Aubertin, G. M., D. W. Smith, and J. H. Patric.
1973. **Quantity and quality of streamflow after area fertilization on a forested watershed: First-year results.** *In* Forest fertilization symp. proc. USDA For. Serv. Gen. Tech. Rep. NE-3. p. 88-100.

30. Aubertin, Gerald M., Benjamin C. Thorner, and John Campbell.
1976. **A precipitation collector and automated pH-monitoring system.** USDA For. Serv. Res. Note NE-220. 8 p.

31. Auchmoody, L. R.
1972. **Effects of fertilizer-nutrient interactions on red oak seedling growth.** USDA For. Serv. Res. Pap. NE-239. 5 p.

32. Auchmoody, L. R.
1972. **Epicormic branching: Seasonal change, influence of fertilization, and frequency of occurrence in uncut stands.** USDA For. Serv. Res. Pap. NE-228. 8 p.

33. Auchmoody, L. R.
1972. **Foliar nutrient variation in four species of upland oak.** Agron. Abstr. p. 136.

34. Auchmoody, L. R.
1972. **Nutrient properties of five West Virginia forest soils.** USDA For. Serv. Res. Note NE-145. 4 p.

35. Auchmoody, L. R.
1973. **Intensive culture of black cherry.** South. Lumberman 227(2824):113-115.

36. Auchmoody, L.
1973. **Response of yellow-poplar, red oak and basswood to fertilization in West Virginia.** Agron. Abstr. p. 137.

37. Auchmoody, L. R.
1974. **Nutrient composition of blades, petioles, and whole leaves from fertilized and unfertilized yellow-poplar.** USDA For. Serv. Res. Note NE-198. 5 p.

38. Auchmoody, L. R.
1976. **Accuracy of band dendrometers.** USDA For. Serv. Res. Note NE-221. 4 p.

39. Auchmoody, L. R., and S. M. Filip.
1973. **Forest fertilization in the Eastern United States: Hardwoods.** *In* Forest

fertilization symp. proc. USDA For. Serv. Gen. Tech. Rep. NE-3. p. 211-225.

40. Auchmoody, L. R., and K. P. Hammack.
1975. Foliar nutrient variation in four species of upland oaks. USDA For. Serv. Res. Pap. NE-331. 16 p.

41. Auchmoody, L. R., and H. Clay Smith.
1971. Four year effects of fertilization and lime on mineral composition of sugar maple foliage. Agron. Abstr. p. 116.

42. Auchmoody. L. R., and G. W. Wendel.
1973. Effect of calcium cyanamide on growth and nutrition of planted yellow-poplar seedlings. USDA For. Serv. Res. Pap. NE-265. 11 p.

43. Banks, W. G., and H. C. Frayer.
1966. Rate of forest fire spread and resistance to control in the fuel types of the eastern region. Fire Control Notes 27:10-13.

44. Banks, Wayne G., and Fred E. Holt.
1966. Who starts forest fires in Maine—and how? USDA For. Serv. Res. Note NE-51. 4 p.

45. Barger, J. H.
1966. Research with systemics. Soc. Munic. Arborists Proc. 2(1):25-28.

46. Barger, J. H.
1967. Shade tree selection and protection. Trees Mag. 47(2):13-15.

47. Barger, Jack H.
1970. Field and laboratory evaluation of methoxychlor for Dutch elm disease vector control. (Abstr.) Miami Beach Meet. Entomol. Soc. Am. p. 50.

48. Barger, Jack H.
1976. Dutch elm disease and methoxychlor. USDA For. Serv. Res. Pap. NE-353. 5 p.

49. Barger, J. H., and R. A. Cuthbert.
1971. Statistical correlations between GLC assay and smaller European elm bark beetle bioassay. (Abstr.) Proc. North Cent. Branch Entomol. Soc. Am. 26:93.

50. Barger, J. H., R. A. Cuthbert, and H. H. Roberto.
1971. Assessment of three pre-cold storage preparations on the feeding response of *Scolytus multistriatus* and degradation of dicrotophos. J. Econ. Entomol. 64:621-624.

51. Barger, J. H., R. A. Cuthbert, and D. G. Seegrist.
1973. Statistical correlations between GLC assay and smaller European elm bark beetle bioassay. J. Econ. Entomol. 66:79-81.

52. Barger, J. H., and Ralph H. Davidson.
1967. A life history study of the ash seed weevils *Thysanocnemis bischoffi* Blatchley and *Thysanocnemis helvola* Leconte. Ohio J. Sci. 67:123-127.

53. Barger, Jack H., and Kenneth Helrich.
1974. Evaluation of aerial applications of Gardona for gypsy moth suppression. (Abstr.) Proc. North Cent. Branch Entomol. Soc. Am. 29:179-180.

54. Barger, Jack H., and Kenneth Helrich.
1975. Field test with helicopter applications of Gardona against gypsy moth in Pennsylvania. USDA For. Serv. Res. Pap. NE-314. 6 p.

55. Barger, J. H., and W. K. Hock.
1971. Distribution of Dutch elm disease and the smaller European elm bark beetle in the United States in 1970. Plant Dis. Rep. 55. p. 271-272.

56. Barlow, Roger.
1971. Oak management for wood products. *In* Oak symp. proc. USDA For. Serv. Northeast For. Exp. Stn. p. 152-158.

57. Barnard, Joseph E.
1975. Sampling with partial replacement contrasted with complete remeasurement inventory designs: an empirical examination. *In* Symp. monitoring forest environment through successive sampling proc. SUNY Coll. Environ. Sci. and For., Syracuse. p. 384-390.

58. Barnard, Joseph E., C. Allen Bickford, and Carl E. Mayer.
1973. Forest survey cubic-foot volume equations. USDA For. Serv. Res. Note NE-166. 2 p.

59. Barnard, Joseph E., and Teresa M. Bowers.
1969. **A glimpse at New York's current timber resource.** USDA For. Serv. Res. Note NE-95. 6 p.

60. Barnard, Joseph E., and Teresa M. Bowers.
1969. **A preview of Ohio's forest resource.** USDA For. Serv. Res. Note NE-97. 4 p.

61. Barnard, Joseph E., and Teresa M. Bowers.
1973. **A preview of Delaware's timber resource.** USDA For. Serv. Res. Note NE-159. 3 p.

62. Barnard, Joseph E., and Teresa M. Bowers.
1973. **A preview of New Jersey's forest resource.** USDA For. Serv. Res. Note NE-177. 3 p.

63. Barnard, Joseph E., and Teresa M. Bowers.
1974. **A preview of New Hampshire's forest resource.** USDA For. Serv. Res. Note NE-197. 5 p.

64. Barnard, Joseph E., and Teresa M. Bowers.
1974. **A preview of Vermont's forest resource.** USDA For. Serv. Res. Note NE-196. 6 p.

65. Barnard, J. E., and Larry Letourneau.
1974. **Data-processing systems for large inventories.** *In* inventory design and analysis, workshop proceedings. Soc. Am. For. p. 137-149.

66. Barnard, Joseph E., and Carl E. Mayer.
1972. **Penn's Sylvania: The current forest resources of Pennsylvania.** Pa. For. 63: 60-64.

67. Bate, L. C., W. S. Lyon, and E. H. Wollerman.
1974. **Gold tagging of elm bark beetles and identification by neutron activation analysis.** Radiochem. Radioanal. Lett. 17(1):77-85.

68. Bauer, Curtis H.
1975. **The consultant's role in municipal watershed management.** *In* Municipal watershed management symp. proc. USDA For. Serv. Gen. Tech. Rep. NE-13. p. 135-140.

69. Baughman, Roger N., and James H. Patric.
1970. **SURBAL: Computerized metes and bounds surveying.** USDA For. Serv. Res. Note NE-110. 7 p.

70. Baumgras, John E.
1971. **Configuration of Appalachian logging roads.** USDA For. Serv. Res. Pap. NE-198. 16 p.

71. Baumgras, John E.
1971. **Logging-machine recording instruments: A new management tool for loggers.** South. Lumberman 223(2776):102-104.

72. Baumgras, John E.
1972. **The third challenge: Management's attitude.** North. Logger 21(2):17-18,41.

73. Baumgras, John E.
1975. **How to avoid axle-weight overloads on tandem-axle log trucks.** North. Logger 24(3):14-15.

74. Baumgras, John E.
1976. **Better load-weight distribution is needed for tandem-axle logging trucks.** USDA For. Serv. Res. Pap. NE-342. 9 p.

75. Bay, Roger R., and J. S. Krammes.
1975. **Research needs related to management of municipal watersheds.** *In* Municipal watershed management symp. proc. USDA For. Serv. Gen. Tech. Rep. NE-13. p. 193-196.

76. Beall, F. C., and G. R. Spoerke.
1973. **Degrade of oak lumber as influenced by drying.** For. Prod. J. 23(11):25-30.

77. Bean, Allan, Robert W. Alperi, and C. A. Federer.
1975. **A method for categorizing shelterbelt porosity.** Agric. Meteorol. 14. p. 417-429.

78. Bean, James L.
1973. **The USDA Forest Service gypsy moth research and development program.** West. For. Insect Work Conf. Proc. 24. p. 5-24.

79. Beardsley, Wendell G.
1971. **The economic impact of recreation development: a synopsis.** *In* Recreation symp. proc. USDA For. Serv. Northeast. For. Exp. Stn. p. 28-32.

80. Beaton, J. D.
1973. **Fertilizer methods and applications to forestry practice.** *In* Forest fertilization symp. proc. USDA For. Serv. Gen. Tech. Rep. NE-3. p. 55-71.

81. Beaton, John A.
1974. **Sensitometry: its uses. Seed x-ray symp. proc.** USDA For. Serv. Southeast. Area, State and Priv. For. p. 85-92.

82. Beaton, John A., William B. White, and Frederick H. Berry.
1972. **Radiography of trees and wood products.** Mater. Eval. 30(10):14A-17A.

83. Behrend, Donald F.
1973. **Wildlife management-forest fertilization relations.** *In* Forest fertilization symp. proc. USDA For. Serv. Gen. Tech. Rep. NE-3. p. 108-110.

84. Bennett, H. D.
1971. **Past present, and potential products from oak.** *In* Oak symp. proc. USDA For. Serv. Northeast. For Exp. Stn. p. 90-93

85. Bent, John E.
1969. **Some benefits, problems, and concerns of a secondary user of yellow birch.** *In* Birch symp. proc. USDA For. Serv. Northeast. For. Exp. Stn. p. 38-39.

86. Benzie, John W., Silas Little, and R. F. Sutton.
1973. **The Northeast and Boreal Region.** J. For. 71:154-158.

87. Berg, W. A.
1969. **Determining pH of strip-mine spoils.** USDA For. Serv. Res. Note NE-98. 7 p.

88. Berg, William A.
1966. **Plant-toxic chemicals in acid spoils.** Pa. State Univ. Coal Mine Spoil Reclam. Symp. Proc. 1965. p. 91-94.

89. Berg, William A.
1970. **Nutritional and physical aspects of plant establishment on mine wastes.** (Abstr.) Coal Age 75(4):112.

90. Berg, W. A., and R. F. May.
1969. **Acidity and plant-available phosphorus in strata overlying coal seams.** Min. Congr. J. 55(3):31-34.

91. Berg, W. A., and W. G. Vogel.
1968. **Manganese toxicity of legumes seeded in Kentucky strip-mine spoils.** USDA For. Serv. Res. Pap. NE-119. 12p.

92. Berg, William A., and Willis G. Vogel.
1973. **Toxicity of acid coal-mine spoils to plants.** *In* Ecology and reclamation of devastated land, Vol. I. Gordon & Breach, New York. p. 57-68.

93. Bergey, Hans T.
1975. **Current management practices on the Providence Municipal Watershed.** *In* Municipal watershed management symp. proc. USDA For. Serv. Gen. Tech. Rep. NE-13. p. 115-123.

94. Berry, Frederick H.
1966. **Diseases.** North. Nut Growers Assoc. Nutshell 14(1):10-13.

95. Berry, Frederick H.
1966. **Diseases.** *In* Black walnut culture. USDA For. Serv. North Cent. For. Exp. Stn. Walnut Workshop. p. 88-90.

96. Berry, Frederick H.
1967. **Sweetgum diseases.** Univ. Mo. Tree Serv. Conf. 1966. p. 22-25.

97. Berry, Frederick H.
1968. **Spread of** *Fomes annosus* **root rot in thinned shortleaf pine plantations.** USDA For. Serv. Res. Note NE-87. 4 p.

98. Berry, Frederick H.
1969. **Decay in the upland oak stands of Kentucky.** USDA For. Serv. Res. Pap. NE-126. 16 p.

99. Berry, Frederick H.
1970. **Walnut anthracnose.** U.S. Dep. Agric. For. Serv. For. Pest Leafl. 85. (Rev.) 4 p.

100. Berry, Frederick H.
1971. **Eight years' loss from** *Fomes annosus* **in thinned shortleaf pine plantations in Missouri.** Plant Dis. Rep. 55:1085-1087.

101. Berry, Frederick H.
1973. **Decay of oak in Ohio.** Ohio Woodlands 11(4):12-13.

102. Berry, Frederick H.
1973. **Diseases.** *In* Black walnut as a crop. Black walnut symp. USDA For. Serv. Gen. Tech. Rep. NC-4. p. 88-90.

103. Berry, Frederick H.
1973. **Heart rots of central region hardwoods.** U.S. Dep. Agric. For. Serv. For. Pest Leafl. 140. 9 p.

104. Berry, Frederick H.
1976. **Decay in oak inoculated with four heart-rot fungi.** (Abstr. 51) Proc. Am. Phytopathol. Soc. 3:215-216.

105. Berry, Frederick H.
1976. ***Phlebia chrysocrea* causes a heart rot of oaks and other hardwoods.** Plant Dis. Rep. 60:308-311.

106. Berry, Frederick H., and John A. Beaton
1971. **Decay not serious in northern red oak.** USDA For. Serv. Res. Note NE-125. 5 p.

107. Berry, Frederick H., and John A. Beaton.
1972. **Decay causes little loss in hickory.** USDA For. Serv. Res. Note NE-152. 4 p.

108. Berry, Frederick H., and John A Beaton.
1972. **Decay in oak in the central hardwood region.** USDA For. Serv. Res. Pap. NE-242. 11 p.

109. Berry, F. H., and T. W. Bretz.
1966. **Small oak bark beetle a potential vector of oak wilt.** Plant Dis. Rep. 50:45-49.

110. Berry, Frederick H., and Winant K. Hock.
1975. **Walnut anthracnose.** U.S. Dep. Agric., Agric. Handb. 470. p. 92-94.

111. Berry, Frederick H., and William Lautz.
1972. **Anthracnose of eastern hardwoods.** U.S. Dep. Agric. For. Serv. For. Pest Leafl. 133. 6 p.

112. Bevins, Malcolm I.
1971. **Private recreation enterprise economics.** *In* Recreation symp. proc. USDA For. Serv. Northeast. For. Exp. Stn. p. 33-39.

113. Bevins, M. I., T. L. Brown, G. L. Cole, K. J. Hock, and W. F. LaPage.
1974. **Analysis of the campground market in the Northeast.** Report II. Privately owned areas. Vt. Agric. Exp. Stn. Bull. 679. 29 p.

114. Biller, Cleveland J.
1969. **Prediction of skidder tire wear in Appalachia.** Am. Soc. Agric. Eng. Winter Meet. Proc. 19 p.

115. Biller, Cleveland J.
1970. **Costlier skidder tires may be cheaper in the long haul.** Can. For. Ind. 90:55-57.

116. Biller, Cleveland J.
1970. **Some observations on causes of skidder tire wear.** North. Logger 18(5):24-25,38.

117. Biller, Cleveland J.
1970. **Tables for estimating skidder tire wear.** USDA For. Serv. Res. Pap. NE-168. 12 p.

118. Biller, Cleveland J.
1971. **Are your log skidder tires too small and underinflated?** For. Ind. 98(13):34-37.

119. Biller, Cleveland J.
1971. **Prediction of skidder tire wear in Appalachia.** Trans. Am. Soc. Agric. Eng. 14(2):350-352.

120. Biller, Cleveland J.
1972. **Are you overloading your skidder tires?** USDA For. Serv. Res. Pap. NE-247. 7 p.

121. Biller, Cleveland J.
1973. **Match your skidder tires to your machine load.** South. Lumberman 226(2809):15,16,18.

122. Biller, Cleveland J., and Robert L. Hartman.
1970. **Buying a used skidder?** Pulpwood Prod. 18(5):46,50,52.

123. Biller, Cleveland J., and Robert L. Hartman.
1970. **Tractive characteristics of wheeled-skidder tires.** Am. Soc. Agric. Eng. ASAE Pap. 70-615. 12 p.

124. Biller, Cleveland J., and Robert L. Hartman.
1971. **Tractive characteristics of wheeled-skidder tires.** Trans. Am. Soc. Agric. Eng. 14:1024-1026,1033.

125. Biller, C. J., and L. R. Johnson.
1973. **Comparing logging systems through simulation.** Trans. Am. Soc. Agric. Eng. 16:1060-1063,1071.

126. Bjorkbom, John C.
1967. **Seedbed preparation methods for paper birch.** USDA For. Serv. Res. Pap. NE-79. 15 p.

127. Bjorkbom, John C.
1968. **Planting paper birch in old fields in Maine.** USDA For. Serv. Res. Pap. NE-103. 12 p.

128. Bjorkbom, John C.
1969. **Seeding and planting birch.** *In* Birch symp. proc. USDA For. Serv. Northeast For Exp. Stn. p. 79-82

129. Bjorkbom, John C.
1971. **Production and germination of paper birch seed and its dispersal into a forest opening.** USDA For. Serv. Res. Pap. NE-209. 14 p.

130. Bjorkbom, John C.
1972. **Stand changes in the first 10 years after seedbed preparation for paper birch.** USDA For. Serv. Res. Pap. NE-238. 10 p.

131. Bjorkbom, John C.
1972. **Ten-year growth of planted paper birch in old fields in Maine.** USDA For. Serv. Res. Pap. NE-246. 6 p.

132. Bjorkbom, John C.
1973. **The effects of various combinations of nitrogen, phosphorus, and potassium on paper birch seedling growth.** USDA For. Serv. Res. Note NE-158. 4 p.

133. Bjorkbom, John C.
1973. **Response of paper birch seedlings to nitrogen, phosphorus, and potassium.** USDA For. Serv. Res. Note NE-157. 4 p.

134. Bjorkbom, John C., and Robert M. Frank.
1968. **Slash burning and whole-tree skidding fail to provide mineral-soil seedbeds for spruce-fir.** North. Logger 16(7):20,45.

135. Bjugstad, A. J., and W. G. Vogel.
1970. **How to manage Ozark glades for good grazing.** USDA For. Serv. North Cent. For. Exp. Stn. 4 p.

136. Black, Peter E., and Raymond E. Leonard.
1968. **The principle of watershed equilibrium.** Water Resour. Bull. 4(2):49-50.

137. Black, Peter E., and Raymond E. Leonard.
1970. **Watershed models for instructional films.** USDA For. Serv. Res. Note NE-113. 4 p.

138. Blanchette, Robert A., and Edward M. Sharon.
1975. ***Agrobacterium tumefaciens*, a promotor of wound healing in *Betula alleghaniensis*.** Can. J. For. Res. 5:722-730.

139. Blevins, R. L., G. M. Aubertin, and N. Holowaychuk.
1968. **A technique for obtaining undisturbed soil samples by freezing *in situ*.** Soil Sci. Soc. Am. Proc. 32:741-742.

140. Blevins, R. L., N. Holowaychuk, and L. P. Wilding.
1970. **Soil genesis, morphology, and classification.** Soil Sci. Soc. Am. Proc. 34:460-465.

141. Blum, Barton M.
1966. **A new mounting platform for dial-gage dendrometers.** J. For. 64:319-322.

142. Blum, Barton M.
1966. **Snow damage in young northern hardwoods and rapid recovery.** J. For. 64:16-18.

143. Blum, Barton M.
1967. **Plastic tubing for collecting maple sap: A comparison of suspended vented and unvented installations.** USDA For. Serv. Res. Pap. NE-79. 15 p.

144. Blum, Barton M.
1967. **A taphole marking device.** Natl. Maple Syrup Dig. 6(3):8-9.

145. Blum, Barton M.
1968. **Plastic tubing: A comparison of suspended vented and unvented installations.** Natl. Maple Syrup Dig. 7(3):10-14.

146. Blum, Barton M.
1971. **Some correlations between sugar maple tree characteristics and sap and sugar yields.** USDA For. Serv. Res. Note NE-143. 4 p.

147. Blum, Barton M.
1972. **Relationship between tree characteristics and maple sugar yields.** Natl. Maple Syrup Dig. 11(3):15,17,19.

148. Blum, Barton M.
1973. **Relation of sap and sugar yields to physical characteristics of sugar maple trees.** For. Sci. 19:175-179.

149. Blum, Barton M.
1973. **Some observations on age relationships in spruce-fir regeneration.** USDA For. Serv. Res. Note NE-169. 4 p.

150. Blum, Barton M.
1974. ***Aralia* L.: Aralia.** *In* Seeds of woody plants in the United States. U.S. Dep. Agric., Agric. Handb. 450. p. 220-222.

151. Blum, Barton M.
1976. **Symposium on the intensive culture of northern forest types, held in Orono, Maine.** North. Logger 25(6):12-13.

152. Blum, Barton M., and Carter B. Gibbs.
1968. **Variation of sugar maple sap yield and its influence on experimental design.** USDA For. Serv. Res. Pap. NE-108. 8 p.

153. Blum, Barton M., and Melvin R. Koelling.
1967. **Are you tapping deep enough?** Natl. Maple Syrup Dig. 6(2):16-17.

154. Blum, Barton M., and Melvin R. Koelling.
1968. **Effect of vacuum pumping on lateral movement of sap in the maple tree bole.** USDA For. Serv. Res. Pap. NE-107. 9 p.

155. Blum, Barton M., and Melvin R. Koelling.
1968. **Vacuum pumping increases sap yields from sugar maple trees.** USDA For. Serv. Res. Pap. NE-106. 14 p.

156. Blum, Barton M., and Arnold Krochmal.
1974. ***Epigea repens* L.: Trailing arbutus.** *In* Seeds of woody plants in the United States. U.S. Dep. Agric., Agric. Handb. 450. p. 380-381.

157. Blum, Barton M., and Dale S. Solomon.
1966. **The accuracy of mean-growth estimates made with dial-gage dendrometers.** USDA For. Serv. Res. Note NE-54. 4 p.

158. Blyth, James E., and James T. Bones.
1974. **Pulpwood production in the Northeast and North Central States for 1973.** North. Logger 23(3):16.

159. Blyth, James E., and James T. Bones.
1976. **Pulpwood production in the Northeast and North Central States in 1975.** North. Logger 25(5):8.

160. Bolinger, J. W., K. C. Elliott, and A. D. Longhouse.
1971. **Monitoring cyclic power demands of a diesel engine.** W. Va. Univ. Agric. Exp. Stn. 54 p.

161. Bond, Robert S.
1972. **Labor intensity and demand in the northeastern primary wood-processing industries.** Part I. North. Logger 20(7):16-18,32.

162. Bond, Robert S.
1972. **A labor situation analysis of the northeastern primary wood-processing industries.** Part II. North. Logger 20(8):18-19,28-29,31.

163. Bond, Robert S.
1972. **Labor supply: A critical problem in certain northeastern primary wood processing industries.** Part III. North. Logger 20(10):18,20,40-43.

164. Bond, Robert S., and Paul E. Sendak.
1970. **The structure of the wood platform industry of the Northeast.** Univ. Mass. Exp. Stn. Bull. 586. 70 p.

165. Bond, Robert S., and James C. Whittaker.
1971. **Hunter-fisherman characteristics: Factors in wildlife management and policy decision.** *In* Recreation symp. proc. USDA For. Serv. Northeast. For. Exp. Stn. p. 128-134.

166. Bones, James T.
1973. **Primary wood-product industries of southern New England—1971.** USDA For. Serv. Resour. Bull NE-30. 17 p.

167. Bones, James T.
1973. **The timber industries of New Jersey and Delaware.** USDA For. Serv. Resour. Bull. NE-28. 17 p.

168. Bones, James T.
1976. **Potential sources of wood fiber in the Northeast.** For. Prod. J. 26(2):30-32.

169. Bones, James T., and Joseph E. Barnard.
1973. **Land clearing and wood use in Delaware, 1972.** USDA For. Serv. Res. Note NE-163. 5 p.

170. Bones, James T., and James E. Blyth.
1970. **Hardwood veneer log production and receipts for 1968.** North. Logger 18(1):34.

1973. **Pulpwood production in the Northeast and North Central States for 1972.** North. Logger 22(4):14,22.

172. Bones, James T., and James E. Blyth. 1975. **Pulpwood production in the Northeast and North Central States for 1974.** North. Logger 24(3):8,29.

173. Bones, James T., and Teresa M. Bowers. 1971. **Wood residues: How much are we recovering?** North. Logger 20(10):22-23,35,47.

174. Bones, James T., and David R. Dickson. 1969. **Primary wood products output in Ohio—1966.** USDA For. Serv. Resour. Bull. NE-18. 18 p.

175. Bones, James T., and David R. Dickson. 1970. **Pulpwood production in the Northeast—1969.** USDA For. Serv. Resour. Bull. NE-22. 34 p.

176. Bones, James T., and David R. Dickson. 1970. **The veneer industry in the Northeast.** USDA For. Serv. Resour. Bull. NE-21. 17 p.

177. Bones, James T., and David R. Dickson. 1971. **Pulpwood production in the Northeast—1970.** USDA For. Serv. Resour. Bull. NE-24. 34 p.

178. Bones, James T., and David R. Dickson. 1973. **Pulpwood production in the Northeast—1971.** USDA For. Serv. Resour. Bull. NE-29. 18 p.

179. Bones, James T., and David R. Dickson. 1973. **Pulpwood production in the Northeast—1972.** USDA For. Serv. Resour. Bull. NE-31. 21 p.

180. Bones, James T., and David R. Dickson. 1974. **Pulpwood production in the Northeast—1973.** USDA For. Serv. Resour. Bull. NE-37. 19 p.

181. Bones, James T., and David R. Dickson. 1974. **The veneer industry in the Northeast—1972.** USDA For. Serv. Resour. Bull. NE-33. 13 p.

182. Bones, James T., and David R. Dickson. 1976. **Pulpwood production in the Northeast—1974.** USDA For. Serv. Resour. Bull. NE-42. 22 p.

1976. **Pulpwood production in the Northeast—1975.** USDA For. Serv. Resour. Bull. NE-45. 21 p.

184. Bones, James T., N. Engalichev, and W. G. Gove.
1974. **The timber industries of New Hampshire and Vermont.** USDA For. Serv. Resour. Bull. NE-35. 25 p.

185. Bones, James T., and Neal P. Kingsley. 1969. **Pulpwood production in the Northeast—1968.** USDA For. Serv. Resour. Bull. NE-15. 30 p.

186. Bones, James T., and Neal P. Kingsley. 1972. **Future use of primary wood fiber for papermaking in the Northeast.** Pulp and Pap. 46:100-101

187. Bones, James T., and Chauncey J. Lohr.
1972. **Primary wood-product industries of Kentucky—1969.** USDA For. Serv. Resour. Bull. NE-25. 38 p.

188. Bones, James T., and Carl E. Mayer.
1969. **Primary wood products output in New York—1967.** USDA For. Serv. Resour. Bull. NE-17. 15 p.

189. Bones, James T., and George H. Pierson.
1975. **Wood recovery during land-clearing operations in New Jersey.** J. For. 73:360-363.

190. Bones, James T., and Robert B. Redett. 1976. **The timber industries of Ohio.** USDA For. Serv. Resour. Bull. NE-40. 26 p.

191. Bones, James T., and John K. Sherwood, Jr.
1972. **Primary wood-product industries of Pennsylvania—1969.** USDA For. Serv. Resour. Bull. NE-27. 34 p.

192. Bonner, F. T., and John A. Crossley.
1974. ***Vitis labrusca* L.: Fox grape.** *In* Seeds of woody plants in the United States. U.S. Dep. Agric., Agric. Handb. 450. p. 853-854.

193. Bormann, F. H., G. E. Likens, and J. S. Eaton.
1969. **Biotic regulation of particulate and solution losses from a forest ecosystem.** BioScience 19:600-610.

194. Bormann, F. H., G. E. Likens, D. W. Fisher, and R. S. Pierce.
1969. **Nutrient loss accelerated by clearcutting of a forest exosystem.** *In* Symposium on primary productivity and mineral cycling in natural ecosystems. Ecol. Soc. Am. and Am. Assoc. Adv. Sci. p. 187-196.

195. Bormann, F. H., G. E. Likens, D. W. Fisher, and R. S. Pierce.
1968. **Nutrient loss accelerated by clearcutting of a forest ecosystem.** Science 159:882-884.

196. Bormann, F. H., G. E. Likens, T. G. Siccama, R. S. Pierce, and J. S. Eaton.
1974. **The export of nutrients and recovery of stable conditions following deforestation at Hubbard Brook.** Ecol. Monogr. 44:255-277.

197. Bowen, David K.
1975. **Soil conservation: A parameter of quality water yields.** *In* Municipal watershed management symp. proc. USDA For. Serv. Gen. Tech. Rep. NE-13. p. 162-166.

198. Boyce, Stephen G., and Roswell D. Carpenter.
1968. **Provisional grade specifications for hardwood growing-stock trees.** USDA For. Serv. Res. Pap. NE-97. 12 p.

199. Brackley, Allen M., and David W. Taber.
1968. **A structural plywood industry for the Northeast.** North. Logger 17(4):18-19,48-50.

200. Branson, Branley A., and Donald L. Batch.
1972. **Effects of strip mining on small-stream fishes in east-central Kentucky.** Wash. Proc. Biol. Soc. 84(59):507-518.

201. Brasier, C. M., and J. N. Gibbs.
1975. **Variation in** *Ceratocystis ulmi:* **Significance of the aggressive and nonaggressive strains.** *In* Dutch elm disease. USDA For. Serv. Northeast. For Exp. Stn. p. 53-66.

202. Breillatt, J. P., J. N. Brantley, H. M. Mazzone, M. E. Martignoni, J. E. Franklin, and N. G. Anderson.
1972. **Mass purification of nucleopolyhedrosis virus inclusion bodies in the K-series centrifuge.** Appl. Microbiol. 23:923-930.

203. Brett, C. P.
1973. **A multidisciplinary approach to stand-management research in the forest ecosystem**. *In* Forest fertilization symp. proc. USDA For. Serv. Gen. Tech. Rep. NE-3. 36-44.

204. Brisbin, Robert L.
1970. **Eastern hemlock (***Tsuga canadensis* **(L.) Carr.)).** USDA For. Serv. Am. Woods Ser. FS-239. 8 p.

205. Brisbin, Robert L.
1972. **A performance test of the log and tree grades for eastern white pine.** USDA For. Serv. Res. Note NE-151. 5 p.

206. Brisbin, Robert L., and Wayne K. Murphey.
1970. **Influence of sewage effluent irrigation on physical and mechanical properties of plantation-grown red pine.** Pa. State Univ. Sch. For. Resour. Res. Briefs 4(1):1-3.

207. Brisbin, R. L., and D. L. Sonderman.
1971. **Tree grades for eastern white pine.** USDA For. Serv. Res. Pap. NE-214. 30 p.

208. Brisbin, Robert L., and David L. Sonderman.
1973. **Birch: An American wood.** USDA For. Serv. Am. Woods Ser. FS-221. 11 p.

209. Brock, Samuel M., William G. Hogan, and Thomas H. Pendleton.
1972. **Workmen's compensation laws: Their application to logging and sawmilling in the Northeast.** J. For. 70:408-410.

210. Brodie, John E., and Jean Nolley.
1974. **Maryland's primary wood industry: A utilization summary and directory.** Md. For. Serv. Dep. Nat. Resour. 59 p.

211. Bruckel, D. W., and E. P. Johnson.
1969. **Effects of pH on rootability of** *Thuja occidentalis.* Plant Propagator 15(4):10.

212. Brush, Robert O.
1974. **Recent developments in landscape assessment research with implications for managing forest land for**

search: Applying the results. USDA For. Serv. Gen. Tech. Rep. NC-9. p. 83-86.

213. Brush, Robert O.
1976. **Perceived quality of scenic and recreational environments: Some methodological issues.** *In* Perceiving environmental quality: Research and applications. Plenum Press, New York. p. 47-58.

214. Brush, Robert O.
1976. **Spaces within the woods: managing forests for visual enjoyment.** J. For. 74:744-747.

215. Brush, Robert O.
1976. **Wildlife research needed by landscape architects.** North Am. Wildl. Nat. Resour. Conf. Trans. 41:561-563.

216. Brush, Robert O., and Thomas A. More.
1976. **Some psychological and social aspects of trees in the city.** *In* Better trees for metropolitan landscapes symp. proc. USDA For. Serv. Gen. Tech. Rep. NE-22. p. 25-29.

217. Buckner, C.H.
1971. **Vertebrate predators.** *In* Toward integrated control. Proc. 3rd Annu. Northeast. For. Insect Work Conf. USDA For. Serv. Res. Pap. NE-194. p. 21-31.

218. Burdekin, D. A., and H. M. Heybroek, eds.
1975. **Dutch elm disease.** USDA For. Serv. Northeast. For. Exp. Stn. 94 p.

219. Burns, Denver P.
1969. **Defects caused by primary borers in white oak.** (Abstr.) Proc. North Cent. Branch Entomol. Soc. Am. 24:39.

220. Burns, Denver P.
1970. **Insect enemies of yellow-poplar.** USDA For. Serv. Res. Pap. NE-159. 15 p.

221. Burns, Denver P.
1971. **The gypsy moth research program.** Natl. Plant Board Annu. Meet. Minutes 45:68-70.

222. Burns, Denver P.
1971. **Insects that hurt the bourbon stave industry.** Wooden Barrel 38(6):6-9.

1971. **Yellow-poplar weevil.** U.S. Dep. Agric. For. Serv. For. Pest Leafl. 125. 5 p.

224. Burns, Denver P.
1973. **The foraging and tending behavior of *Dolichoderus taschenbergi* (hymenoptera: Formicidae).** Can. Entomol. 105:97-104.

225. Burns, Denver P., and Ralph H. Davidson.
1966. **The amino acids and sugars in honeydew of the tuliptree scale, *Toumeyella liriodendri*, and in the sap of its host, yellow-poplar.** Ann. Entomol. Soc. Am. 59:1071-1073.

226. Burns, Denver P., and David E. Donley.
1970. **Biology of the tuliptree scale.** *Toumeyella liriodendri* **(Homoptera: Coccidae).** Ann. Entomol. Soc. Am. 63:228-235.

227. Burns, Denver P., and David E. Donley.
1971. **Quantitative field collection of honeydew.** Ann. Entomol. Soc. Am. 64:532-534.

228. Burns, Denver P., and Lester P. Gibson.
1968. **The leaf-mining weevil of yellow-poplar.** Can. Entomol. 100:421-429.

229. Burton, D. H., H. W. Anderson, and L. F. Riley.
1969. **Natural regeneration of yellow birch in Canada.** *In* Birch symp. proc. USDA For. Serv. Northeast. For. Exp. Stn. p. 55-73.

230. Byrne, Kevin J., William E. Gore, Glenn T. Pearce, and Robert M. Silverstein.
1975. **Porapak-Q collection of airborne organic compounds serving as models for insect pheromones.** J. Chem. Ecol. 1(1):1-7.

231. Callahan, John C.
1966. **Economic returns associated with fifty nonindustrial private woodlands.** Purdue Univ. Res. Bull. 815. 16 p.

232. Campbell, R. W.
1966. **Gypsy moth egg-mass density and subsequent defoliation.** USDA For. Serv. Res. Note NE-44. 6 p.

233. Campbell, R. W.
1971. **Developing a pest population**

management system. Proc. Tall Timbers Conf. Ecol. Control Anim. Habitat Manage. p. 9-20.

234. Campbell, Robert W.
1967. **The analysis of numerical change in gypsy moth populations.** For. Sci. Monogr. 15. 33 p.

235. Campbell, Robert W.
1967. **Studies on the sex ratio of the gypsy moth.** For. Sci. 13:19-22.

236. Campbell, Robert W.
1968. **Measuring age specific mortality factors of the gypsy moth.** Proc. North Cent. Branch Entomol. Soc. Am. 67:53-56.

237. Campbell, Robert W.
1969. **Studies on gypsy moth population dynamics.** *In* Forest insect population dynamics. USDA For. Serv. Res. Pap. NE-125. p. 29-34.

238. Campbell, Robert W.
1971. **Introduction.** *In* Toward integrated control. Proc. 3rd Annu. Northeast. For. Insect Work Conf. USDA For. Serv. Res. Pap. NE-194. p. 1.

239. Campbell, Robert W.
1971. **What's new in entomology and pathology?** Soc. Am. For. Allegheny Sect. Winter Meet. Proc. p. 1-3.

240. Campbell, Robert W.
1973. **The conceptual organization of research and development necessary for future pest management.** *In* Pest management for the 21st century. Idaho Res. Found. Nat. Resour. Ser. 2. p. 23-38.

241. Campbell, Robert W.
1973. **Forecasting gypsy moth egg-mass density.** USDA For. Serv. Res. Pap. NE-268. 19 p.

242. Campbell, Robert W.
1973. **Numerical behavior of a gypsy moth population system.** For. Sci. 19:162-167.

243. Campbell, Robert W.
1974. **Relation between overstory composition and subsequent defoliations by the gypsy moth.** J. For. 72:142-143.

244. Campbell, Robert W.
1974. **Relationships between overstory composition and gypsy moth egg-mass density.** USDA For. Serv. Res. Note NE-191. 6 p.

245. Campbell, Robert W.
1975. **The gypsy moth and its natural enemies.** U.S. Dep. Agric., Agric. Inf. Bull. 381. 27 p.

246. Campbell, Robert W.
1975. **The role of trial and error in developing an integrated pest population management system.** *In* Symp. monitoring forest environment through successive sampling proc. SUNY Coll. Environ. Sci. and For., Syracuse. p. 316-320.

247. Campbell, Robert W.
1968. **The ecology of insect population in theory and practice. (Review.)** For. Sci. 14:351.

248. Campbell, Robert W.
1976. **The bimodality of gypsy moth,** *Porthetria dispar* **(L.) (Lepidoptera: Lymantriidae) populations.** J. N.Y. Entomol. Soc. 83:287-288.

249. Campbell, Robert W.
1976. **Comparative analysis of numerically stable and violently fluctuating gypsy moth populations.** Environ. Entomol. 5:1218-1224.

250. Campbell, Robert W., David L. Hubbard, and Ronald J. Sloan.
1975. **Location of gypsy moth pupae and subsequent pupal survival in sparse, stable populations.** Environ. Entomol. 4:597-600.

251. Campbell, Robert W., David L. Hubbard, and Ronald J. Sloan.
1975. **Patterns of gypsy moth occurrence within a sparse and numerically stable population.** Environ. Entomol. 4:535-542.

252. Campbell, Robert W., Marilyn G. Miller, Edward J. Duda, Cynthia E. Biazak, and Ronald J. Sloan.
1976. **Man's activities and subsequent gypsy moth egg-mass density along the forest edge.** Environ. Entomol. 5:273-276.

253. Campbell, R. W., and J. D. Podgwaite.
1971. **The disease complex of the gypsy moth. I. Major components.** J. Invertebr. Pathol. 18:101-107.

254. Campbell, Robert W., and Ronald J. Sloan.
1976. **Influence of behavioral evolution on gypsy moth pupal survival in sparse populations.** Environ. Entomol. 5:1211-1217.

255. Campbell, Robert W., and Joseph P. Standaert.
1974. **Forecasting defoliation by the gypsy moth in oak stands.** USDA For. Serv. Res. Note NE-193. 7 p.

256. Campbell, Robert W., and Harry T. Valentine.
1972. **Tree condition and mortality following defoliation by the gypsy moth.** USDA For. Serv. Res. Pap. NE-236. 331 p.

257. Cannon, William N., Jr.
1970. **A disposable insulated container for rearing fall webworm larvae in the laboratory.** USDA For. Serv. Res. Note NE-123. 3 p.

258. Cannon, William N., Jr.
1970. **Distribution records of the locust leaf miner, *Odontota dorsalis* (Thun.), in the United States.** Entomol. News 81:115-120.

259. Cannon, William N., Jr., and David P. Worley.
1976. **Dutch elm disease control: Performance and costs.** USDA For. Serv. Res. Pap. NE-345. 7 p.

260. Carl, Clayton M., Jr.
1976. **Effect of separation in n-pentane on storability of sugar maple seeds.** USDA For. Serv. Res. Note NE-218. 3 p.

261. Carl, Clayton M., Jr., John R. Donnelly, and Boyd W. Post.
1973. **Effect of moisture and fertilizer on sugar maple seedlings.** Univ. Vt. Agric. Exp. Stn. Res. Rep. MP79. 6 p.

262. Carl, Clayton M., Jr., and Albert G. Snow, Jr.
1971. **Maturation of sugar maple seed.** USDA For. Serv. Res. Pap. NE-217. 8 p.

263. Carl, Clayton M., Jr., and Harry W. Yawney.
1966. **Four stratification media equally effective in conditioning sugar maple seed for germination.** Tree Plant. Notes 77:24-28.

264. Carl, Clayton M., and Harry W. Yawney.
1969. **The use of pentane to separate filled and empty sugar maple samaras.** Tree Plant. Notes 29(3):24-27.

265. Carl, Clayton M., Jr., and Harry W. Yawney.
1972. **Multiple seedlings in** ***Acer saccharum.*** Torrey Bot. Club Bull. 99:142-144.

266. Carlson, T. C.
1968. **Estimating hourly production of sliced wood.** For. Prod. J. 18(11):45-49.

267. Carlson, Tony C.
1966.**The market for wood pallets in the steel industry.** USDA For. Serv. Res. Pap. NE-53. 15 p.

268. Carmean, Willard H.
1970. **Site quality for eastern hardwoods.** *In* The silviculture of oaks and associated species. USDA For. Serv. Res. Pap. NE-144. p. 36-56.

269. Carmean, Willard H.
1971. **Soil-site relationships of the upland oaks.** *In* Oak symp. proc. USDA For. Serv. Northeast. For. Exp. Stn. p. 23-29.

270. Carmean, Willard H., F. Bryan Clark, Robert D. Williams, and Peter R. Hannah.
1976. **Hardwoods planted in old fields favored by prior tree cover.** USDA For. Serv. Res. Pap. NC-134. 16 p.

271. Carpenter, B. E., Jr. and J. G. Schroeder.
1968. **Combined effects of drying, surfacing, and trimming on grade and volume of southern pine lumber.** USDA For. Serv. Res. Note SE-93.

272. Carpenter, R. D.
1966. **Making better grade lumber from your hardwood logs.** South. Lumberman 212(2637):31-32,34,38.

273. Carpenter, Roswell, D.
1966. **Hardwood log and tree grades.** Ky. Governor's Conf. For. Proc. 3 p. 23-30.

274. Carpenter, Roswell D.
1967. **Major defects in southern hardwood veneer logs and bolts.** South. Lumberman 214(2668):18, 20, 22, 24, 26.

275. Carpenter, Roswell D.
1967. **Making better grade lumber from your hardwood logs. Part II.** Natl. Hardwood Lumber Assoc. Yearb., 1967. p. 147-148, 150, 152, 154, 156, 158.

276. Carpenter, Roswell D.
1969. **Bolt, log, and tree grades for birch.** *In* Birch symp. proc. USDA For. Serv. Northeast For. Exp. Stn. p. 26-32.

277. Carroll, W. J., and W. E. Waters.
1967. **Eastern hemlock looper** *Lambdina fiscellaria fiscellaria* (Guen.). *In* Important forest insects and diseases of mutual concern to Canada, the United States and Mexico. Can. Dep. For Rural Dev. Publ. 1180. p. 120-122.

278. Carvell, Kenneth L.
1971. **Silvicultural aspects of intermediate cuttings.** *In* Oak symp. proc. USDA For. Serv. Northeast. For. Exp. Stn. p. 60-64.

279. Cech, Franklin C.
1971. **Tree improvement research in oak species.** *In* Oak symp. proc. USDA For. Serv. Northeast. For. Exp. Stn. p. 55-59.

280. Champagne, E. Garth.
1966. **Lumber care and handling.** Ky. Governor's Conf. For. Proc. 3:55-62.

281. Chapelle, D. E.
1967. **Financial maturity of eastern white pine in New York State.** N.Y. State Univ. Coll. For. Tech. Publ. 91. 261 p.

282. Chapman, R. C.
1969. **Modeling forest insect populations: The stochastic approach.** *In* Forest insect population dynamics. USDA For. Serv. Res. Pap. NE-125. p. 73-88.

283. Church, Thomas W., Jr.
1966. **Can you afford to grade your hardwood logs?** North. Logger 14(12): 12-13.

284. Church, Thomas W., Jr.
1966. **The cost of scaling and grading hardwood sawlogs.** USDA For. Serv. Res. Pap. NE-49. 21 p.

285. Church, Thomas W., Jr.
1966. **Opportunities for improving markets for wood crossties.** Crosstie Bull. 49(2):20-31.

286. Church, Thomas W., Jr.
1966. **Opportunities for improving the manufacture and serviceability of railroad crossties.** North. Logger 14(7): 18-19. 38-40.

287. Church, Thomas W., Jr.
1969. **Don't leave your defective maple butts in the woods.** North. Logger 17(11):24-25,39.

288. Church, Thomas W., Jr.
1970. **Appalachian loggers: Take the better roads for quicker trips.** South. Lumberman 221(2752):109-112.

289. Church, Thomas W., Jr.
1971.**Technical considerations in harvesting and sawing defective hardwood butts.** USDA For. Serv. Res. Pap. NE-189. 17 p.

290. Church, Thomas W., Jr.
1972. **The CHUBALL: A unique new device for selectively logging steep slopes.** North. Logger 21(2):8-9,27,33.

291. Church, Thomas W., Jr.
1973. **The significance of sweep in Appalachian hardwood sawlogs.** USDA For. Serv. Res. Note NE-172. 4 p.

292. Church, Thomas W., Jr.
1975. **Steam up with old crossties? Maybe!** South. Lumberman 231(2872): 78.

293. Church, Thomas W., Jr.
1976. **Old crossties: A potential energy source for wood preserving plants.** Am. Wood Preserv. Assoc. Proc. p. 87-97.

294. Church, Thomas W., Jr., and Lawrence D. Garrett.
1970. **Should a hardwood lumber producer saw ties and timber, too?** North. Logger 18 (10):16,18,20-22,54.

295. Church, Thomas W., Jr., and R. M. Godman.
1966. **The formation and development of dormant buds in sugar maple.** For. Sci. 12:301-306.

296. Church, Thomas W., Jr., and George R. Niskala.
1966. **An elixir for sawmills: Cut cants.** North. Logger 14(10):18-19,44.

297. Church, Thomas W., Jr., and John W. Pearce.
1976. **Weights of crossties removed from service.** Cross Ties 57(2):25-31.

1970. **Measures necessary for natural regeneration of oaks, yellow-poplar, sweetgum, and black walnut.** *In* The silviculture of oaks and associated species. USDA For. Serv. Res. Pap. NE-144. p. 1-16.

299. Clark, F. Bryan.
1975. **La plantation du noyer noir a bois.** Bull. de la vulg. for. 75/2:50-51.

300. Clark, F. Bryan, and Richard F. Watt.
1971. **Silvicultural methods for regenerating oaks.** *In* Oak symp. proc. USDA For. Serv. Northeast. For. Exp. Stn. p. 37-43.

301. Clark, Roger N.
1971. **Undesirable behavior in forest campgrounds.** *In* Recreation symp. proc. USDA For Serv. Northeast. For. Exp. Stn. p. 150-155.

302. Clausen, Knud E., and Peter W. Garrett.
1969. **Progress in birch genetics and tree improvement.** *In* Birch symp. proc. USDA For. Serv. Northeast. For. Exp. Stn. p. 86-94.

303. Cliff, Edward P.
1969. **Our birch resources.** *In* Birch symp. proc. USDA For. Serv. Northeast. For. Exp. Stn. p. 1-5.

304. Cole, Gerald L., and Bruce T. Wilkins.
1971. **The camper.** *In* Recreation symp. proc. USDA For. Serv. Northeast. For. Exp. Stn. p. 105-112.

305. Coleman, Ronald E., and Hugh W. Reynolds.
1973. **Sawing SHOLO logs: Three methods.** USDA For. Serv. Res. Pap. NE-279. 5 p.

306. Collins, D. L.
1971. **Toward integrated control.** *In* Toward integrated control. Proc. 3rd Annu. Northeast. For Insect Work Conf. USDA For. Serv. Res. Pap. NE-194. p. 2-6.

307. Collins, E. B., and K. C. Elliott.
1973. **Possible power sources for forest industry use.** W. Va. Univ. Agric. Exp. Stn. 70 p.

308. Collins, William H.
1976. **Nursery growing practices as related to selection and production of municipal trees.** *In* Better trees for metropolitan landscapes symp. proc.

NE-22. p. 167-177.

309. Conklin, James G.
1969. **Insect enemies of birch.** *In* Birch symp. proc. USDA For Serv. Northeast. For. Exp. Stn. p. 151-154.

310. Conner, R. N., and H. S. Crawford.
1974. **Woodpecker foraging in Appalachian clearcuts.** J. For. 72:564-566.

311. Connola, D. P., F. B. Lewis, and J. L. McDonough.
1966. **Experimental field techniques used to evaluate gypsy moth, *Porthetria dispar*, control in New York.** J. Econ. Entomol. 59:284-287.

312. Constantinidou, H., T. T. Kozlowski, and K. F. Jensen.
1976. **Effects of sulfur dioxide in *Pinus resinosa* seedlings in the cotyledon state.** J. Environ. Qual. 5:141-144.

313. Corbett, E. S.
1971. **Status of management on forested municipal watersheds in Northeast.** Pa. For. 62(4):100-101.

314. Corbett, Edward S.
1967. **Measurement and estimation of precipitation on experimental watersheds.** *In* International symp. on forest hydrology proc. Pergamon Press, Oxford, England. p. 107-129.

315. Corbett, Edward S.
1970. **The management of forested watersheds for domestic water supplies.** Multiple-Use South. For. Conf. Proc. 1969. Ga. For. Res. Counc. and Ga. For. Assoc. p. 35-38.

316. Corbett, Edward S., and John M. Heilman.
1975. **Effects of management practices on water quality and quantity: The Newark, New Jersey, municipal watersheds.** *In* Municipal watershed management symp. proc. USDA For. Serv. Gen. Tech. Rep. NE-13. p. 47-57.

317. Corbett, Edward S., James A. Lynch, and William E. Sopper.
1975. **Forest-management practices as related to nutrient leaching and water quality.** *In* Conference on non-point sources of water pollution proc. Va. Polytech. Inst. and State Univ. Va. Water Resour. Res. Cent. p. 157-173.

318. Corbett, E. S., W. E. Sopper, and J. A. Lynch.
1975. **Watershed response to partial area applications of simulated rainfall.** Proc. Int. Symp. Hydrol. IASH-AISH Publ. 117. p. 63-73.

319. Corbett, Edward S., William E. Sopper, and James Lynch.
1975. **Municipal watershed management: What are the opportunities?** *In* Forestry issues in urban America. Proc. Soc. Am. For. 1974. p. 50-57.

320. Corbett, Edward S., and Warren Spencer.
1975. **Effects of management practices on water quality and quantity: Baltimore, Maryland, municipal watersheds.** *In* Municipal watershed management symp. proc. USDA For. Serv. Gen. Tech. Rep. NE-13. p. 25-31.

321. Core, Earl L.
1971. **Silvical characteristics of the five upland oaks.** *In* Oak symp. proc. USDA For. Serv. Northeast. For. Exp. Stn. p. 19-22.

322. Core, Earl L.
1974. **Brambles.** *In* Shrubs and vines for northeastern wildlife. USDA For. Serv. Gen. Tech. Rep. NE-9. p. 16-19.

323. Core, Earl L.
1974. **Red mulberry.** *In* Shrubs and vines for northeastern wildlife. USDA For. Serv. Gen. Tech. Rep. NE-9. p. 106-107

324. Core, Earl L.
1974. **Spireas.** *In* Shrubs and vines for northeastern wildlife. USDA For. Serv. Gen. Tech. Rep. NE-9. p. 132-133.

325. Cosenza, B. J., and F. B. Lewis.
1966. **Taxonomic considerations of four "wild-type crystalliferous bacilli and their toxicity to larvae of the gypsy moth,** ***Porthetria dispar.*** J. Invertebr. Pathol. 8:520-525.

326. Cosenza, B. J., and J. D. Podgwaite.
1966. **A new species of** ***Proteus*** **isolated from larvae of the gypsy moth,** *Porthetria dispar* (L.). Antonie van Leeuwenhoek 32:187-191.

327. Cosenza, Benjamin J., Mathilda McCreary, John D. Buck, and Alex L. Shigo.
1970. **Bacteria associated with discolored and decayed tissues in beech, birch, and maple.** Phytopathology 69:1547-1551.

328. Cowan, R. L., J. S. Jordan, J. L. Grimes, and J. D. Gill.
1970. **Comparative nutritive values of forage species.** *In* Range and wildlife habitat evaluation: a research symp. U.S. Dep. Agric. For. Serv. Misc. Publ. 1147. p. 48-56.

329. Cowling, E. B., and L. S. Dochinger.
1976. **The changing chemistry of precipitation and its effects on vegetation and materials.** (Abstr.) Am. Inst. Chem. Eng. 69th Mfg. Booklet Pap. 118e. p. 176.

330. Craft, E. Paul.
1970. **Construction-grade plywood from grade 3 Appalachian oak.** USDA For. Serv. Res. Pap. NE-163. 30 p.

331. Craft, E. Paul.
1971. **Construction-grade plywood from grade 3 hardwood: An industrial possibility.** For. Prod. J. 21(2):26-30.

332. Craft, E. Paul.
1975. **Construction-grade hardwood plywood industry: An Appalachian opportunity.** Plywood & Panel 16(5):26-28.

333. Craft, E. Paul.
1976. **Utilizing hardwood logging residue: A case study in the Appalachians.** USDA For. Serv. Res. Note NE-230. 7 p.

334. Crawford, Hewlette S.
1976. **Relationships between forest cutting and understory vegetation: An overview of eastern hardwood stands.** USDA For. Serv. Res. Pap. NE-349. 9 p.

335. Crawford, Hewlette S., R. G. Hooper, and R. F. Harlow.
1976. **Woody plants selected by beavers in the Appalachian Ridge and Valley Province.** USDA For. Serv. Res. Pap. NE-346. 6 p.

336. Crawford, H. S., and I. R. Porter.
1974. **Upland hardwood-bluestem.** *In* Range resources of the South. Ga. Agric. Exp. Stn. Bull. NE-9. p. 17-19.

1976. **Some approaches to collecting ornamental trees and shrubs.** *In* Better trees for metropolitan landscapes symp. proc. USDA For. Serv. Gen. Tech. Rep. NE-22. p. 221-226.

338. Cromer, Jack I.
1974. **American bittersweet.** *In* Shrubs and vines for northeastern wildlife. USDA For. Serv. Gen. Tech. Rep. NE-9. p. 10-11.

339. Cromer, Jack I., and H. Clay Smith.
1968. **Sufficient deer browse produced by a wide range of cutting practices.** Trans. Northeast. Fish Wildl. Conf. 25:25-33.

340. Crossley, John A.
1974. ***Malus* Mill.: Apple.** *In* Seeds of woody plants in the United States. U.S. Dep. Agric., Agric. Handb. 450. p. 531-534.

341. Crossley, John A.
1974. ***Solanum dulcamara* L.: Bitter nightshade.** *In* Seeds of woody plants in the United States. U.S. Dep. Agric., Agric. Handb. 450. p. 777-778.

342. Crossley, John A.
1974. ***Vaccinium* L.: Blueberry.** *In* Seeds of woody plants in the United States. U.S. Dep. Agric., Agric. Handb. 450. p. 840-843.

343. Cuppett, Donald G.
1966. **Air-drying practices in the central Appalachians.** USDA For. Serv. Res. Pap. NE-56. 19 p.

344. Cuppett, Donald G.
1967. **Orientation.** Ky. Governor's Conf. For. Proc. 4. p. 1-3.

345. Cuppett, Donald G., and E. Paul Craft.
1971. **Low-temperature drying of 4/4 Appalachian red oak.** For. Prod. J. 21(1):34-38.

346. Cuppett, Donald G., and E. Paul Craft.
1972. **Kiln-drying of presurfaced 4/4 Appalachian oak.** For. Prod. J. 22(6):36-41.

347. Cuppett, Donald G., and E. Paul Craft.
1975. **Low-temperature forced air drying of Appalachian hardwoods.** USDA For. Serv. Res. Pap. NE-328. 10 p.

348. [Cuppett, Donald G., David M. Emanuel, and Paul S. Wysor.]
system for low-grade hardwood logs. South. Lumberman 225(2799):11-14.

349. Curtis, Willie R.
1966. **Forest zone helps minimize flooding in the Driftless area.** J. Soil & Water Conserv. 21:101-102.

350. Curtis, Willie R.
1966. **Response of springflow to some climatic variables in southwestern Wisconsin.** Water Resour. Res. 2:311-314.

351. Curtis, Willie R.
1967. **Hydrology.** Ky. Dep. Nat. Resour. Strip Min. Symp. Proc. 3 p.

352. Curtis, Willie R.
1967. **Simple practices along forest edge reduce upland runoff.** J. Soil & Water Conserv. 22:25-26.

353. Curtis, Willie R.
1971. **Strip-mining, erosion and sedimentation.** Trans. Am. Soc. Agric. Eng. 14(3):434-436.

354. Curtis, Willie R.
1971. **Terraces reduce runoff and erosion on surface-mine benches.** J. Soil & Water Conserv. 26:198-199.

355. Curtis, Willie R.
1971. **Vegetating strip-mine spoils for runoff and erosion control.** *In* Revegetation and economic use of surface-mined land and mine refuse symp. proc. W. Va. Univ. Sch. Mines, Morgantown. p. 40-41.

356. Curtis, Willie R.
1972. **Chemical changes in streamflow following surface mining in eastern Kentucky.** 4th Symp. Coal Mine Drain. Res. Mellon Inst. p. 19-31.

357. Curtis, Willie R.
1972. **Strip-mined mountain watersheds have greater flood potential.** *In* Watersheds in transition. Am. Water Resour. Assoc. Symp. p. 357-360.

358. Curtis, Willie R.
1973. **Effects of strip mining on the hydrology of small mountain watersheds in Appalachia.** *In* Ecology and reclamation of devastated land, Vol. I. Gordon & Breach, New York. p. 145-156.

359. Curtis, Willie R.
1973. **Moisture and density relations on graded strip-mine spoils.** *In* Ecology and reclamation of devastated land, Vol. I. Gordon & Breach, New York. p. 135-144.

360. Curtis, Willie R.
[1974] **Introduction.** Univ. Ky. Symp. on Use of Small Watersheds in Determining Eff. of For. Land Use on Water Qual. Proc.

361. Curtis, Willie R.
1974. **Sediment yield from strip-mined watersheds in eastern Kentucky.** 2nd Res. and Appl. Tech. Symp. on Mined-Land Reclam. Natl. Coal Assoc. p. 88-100.

362. Curtis, Willie R., and William D. Cole.
1972. **Microtopographic profile gage.** J. Am. Soc. Agric. Eng. 53(1):17.

363. Curtis, Willie R., and David N. Tolsted.
1967. **Chart holder uses old typewriter parts.** Agric. Eng. 48:154-155.

364. Cuthbert, R. A., J. H. Barger, A. C. Lincoln, and P. A. Reed.
1973. **Formulation and application of methoxychlor for elm bark beetle control.** USDA For. Serv. Res. Pap. NE-283. 6 p.

365. Cuthbert, R. A., W. N. Cannon, Jr., and J. W. Peacock.
1975. **Relative importance of root grafts and bark beetles to the spread of Dutch elm disease.** USDA For. Serv. Res. Note NE-206. 4 p.

366. Cuthbert, Roy A., A. Charles Lincoln, Bruce H. Kennedy, and Nick H. Roberto.
1970. **Laboratory assay of** *Scolytus multistriatus* **and** *Dendrosoter protuberans* **on DDT and Methoxychlor.** J. Econ. Entomol. 63:1889-1891.

367. Cuthbert, Roy A., and John W. Peacock.
1975. **Attraction of** *Scolytus multistriatus* **to Pheromone-baited traps at different heights.** Environ. Entomol. 4:889-890.

368. Czapowskyj, Miroslaw M.
1969. **Anthracite coal-mine spoils today—forests tomorrow.** Pa. For. 59(3):81-83.

369. Czapowskyj, Miroslaw.
1969. **Review of "Forest fertilization: Theory and practice."** Soil Sci. 107:311.

370. Czapowskyj, Miroslaw M.
1970. **Experimental planting of 14 tree species on Pennsylvania's anthracite strip-mine spoils.** USDA For. Serv. Res. Pap. NE-155. 18 p.

371. Czapowskyj, Miroslaw M.
1970. **Performance of hybrid poplars planted on anthracite coal mine spoils.** Agron. Abstr., 1970:158.

372. Czapowskyj, Miroslaw M.
1971. **Review of "Forest fertilization: Waldduengung."** Soil Sci. 3:271.

373. Czapowskyj, Miroslaw M.
1973. **Establishing forest on surface-mined land as related to fertility and fertilization.** *In* Forest fertilization symp. proc. USDA For. Serv. Gen. Tech. Rep. NE-3. p. 132-139.

374. Czapowskyj, Miroslaw M.
1973. **Performance of red pine and Japanese larch planted on anthracite coalbreaker refuse.** *In* Ecology and reclamation of devastated land, Vol. II. Gordon & Breach, New York. p. 237-245.

375. Czapowskyj, Miroslaw M.
1973. **Review of "Bodengeographie (Geography of soils),"** by Robert Ganssen in cooperation with Zlatko Gracanin (Koehler Publ. Co., Stuttgart). Soil Sci. 116:453-454.

376. Czapowskyj, Miroslaw M.
1975. **Review of "Forstliche Pflanzenernaehrung und Duengung,"** by Hans J. Fiedler, Wolfgang Nebe and Friedrick Hoffman; Fischer Verlag, Jena. Soil Sci. 120:314.

377. Czapowskyj, Miroslaw M.
1976. **Annotated bibliography on the ecology and reclamation of drastically disturbed areas.** USDA For. Serv. Gen. Tech. Rep. NE-21; 98 p.

378. Czapowskyj, M. M., R. M. Frank, and R. V. Rourke.
1976. **Strip clearcutting does not degrade soil properties in spruce-fir**

1976:183.

379. Czapowskyj, Miroslaw M., and William E. McQuilkin.
1966. **Survival and early growth of planted forested trees on strip-mine spoils in the anthracite region.** USDA For. Serv. Res. Pap. NE-46. 29 p.

380. Czapowskyj, Miroslaw M., John P. Mikulecky, and Edward A. Sowa.
1968. **Response of crownvetch planted on anthracite breaker refuse.** USDA For. Serv. Res. Note NE-78. 7 p.

381. Czapowskyj, Miroslaw M., and Edward A. Sowa.
1973. **Lime retention in anthracite coalbreaker refuse.** USDA For. Serv. Res. Note NE-154. 4 p.

382. Czapowskyj, Miroslaw M., and Edward A. Sowa.
1976. **Lime helps establish crownvetch on coal-breaker refuse.** USDA For. Serv. Res. Pap. NE-348. 6 p.

383. Czapowskyj, Miroslaw M., and Ross Writer.
1970. **Hydroseeding on anthracite coal-mine spoils.** USDA For. Serv. Res. Note NE-124. 8 p.

384. Daft, M. J., and E. Hacskaylo.
1976. **Arbuscular mycorrhizas in the anthracite and bituminous coal wastes of Pennsylvania.** J. Appl. Ecol. 13:523-531.

385. Dale, Martin E.
1968. **Growth response from thinning young even-aged white oak stands.** USDA For. Serv. Res. Pap. NE-112. 19 p.

386. Dale, Martin E.
1972. **Growth and yield predictions for upland oak stands 10 years after initial thinning.** USDA For. Serv. Res. Pap. NE-241. 21 p.

387. Dale, Martin E.
1973. **Growth and yield functions for thinned upland oak stands.** Diss. Abstr. 34(1):10B.

388. Dale, Martin E.
1975. **Effect of understory removal on growth of upland oak.** USDA For. Serv. Res. Pap. NE-321. 10 p.

1975. **State technical assistance programs.** *In* Municipal watershed management symp. proc. USDA For. Serv. Gen. Tech. Rep. NE-13. p. 181-184.

390. Davenport, O. M., and Russell S. Walters.
1967. **Christmas tree culture in Kentucky.** Ky. Agric. Exp. Stn. Misc. Publ. 346. 55 p.

391. Davidson, A. G., and M. E. Fowler.
1967. **Scab and black canker of willow, *Pollaccia saliciperda* (All. and Tub.) Arx (Syn: *Fusicladium saliciperdum* (All. and Tub.)) and *Physalospora miyabeana* Fukushi.** *In* Important forest insects and diseases of mutual concern to Canada, the United States and Mexico. Can. Dep. For. Rural Dev. Publ. 1180. p. 201-203.

392. Davidson, Walter H.
1970. **Deer prefer pine seedlings growing near black locust.** USDA For. Serv. Res. Note NE-111. 4 p.

393. Davidson, Walter H.
1970. **Planned program of tree and shrub planting enhances beauty of America's Great Plains.** Natl. Acad. Sci. Highway Res. News 40:22-26.

394. Davidson, Walter H.
1974. **Reclaiming refuse banks from underground bituminous mines in Pennsylvania.** Symp. Mine and Prep. Plant Refuse Disposal Proc. Natl. Coal Assoc. p. 186-199.

395. Davidson, Walter H.
1975. **Amendments aid reclamation plantings on bituminous mine spoils in Pennsylvania.** Pa. For. 65:101-104.

396. Davidson, Walter H., and Grant Davis.
1972. **Sprouting of thinned hybrid poplars on bituminous strip-mine spoils in Pennsylvania.** USDA For. Serv. Res. Note NE-147. 6 p.

397. Davidson, Walter H., and David H. Dawson.
1968. **Trees and shrubs for roadside beautification.** Dakota Farmer 6 April 1968. p. 33-35.

398. Davidson, Walter H., and Edward A. Sowa.
1974. **Container grown seedlings show**

potential for afforestation of Pennsylvania coal-mine spoils. Tree Plant. Notes 25(4):6-9.

399. Davidson, Walter H., and Edward A. Sowa.
1974. **Early attempts to vegetate coal-mine spoils with container-grown seedlings.** *In* North American containerized forest tree seedling symp. proc. Great Plains Agric. Counc. Publ. 68. p. 372-376.

400. Davis, Donald D., and Henry D. Gerhold.
1976. **Selection of trees for tolerance of air pollutants.** *In* Better trees for metropolitan landscapes symp. proc. USDA For. Serv. Gen. Tech. Rep. NE-22. p. 61-66.

401. Davis, Grant.
1966. **The cooperative research program in Pennsylvania.** Pa. State Univ. Coal Mine Spoil Reclam. Symp. Proc. 1965. p. 55-61

402. Davis, Grant.
1967. **Hydrology of contour strip mines in the Appalachian region of the United States.** 14th IUFRO Congr. Pap. Sect. 11:420-443.

403. Davis, Grant.
1967. **Revegetation.** Ky. Dep. Nat. Resour. Strip Min. Symp. Proc. 3 p.

404. Davis, Grant.
1970. **Research on revegetation and hydrology of surface-mined areas.** (Abstr.) Coal Age 75(4):112.

405. Davis, Grant, ed.
1971. **A guide for revegetating bituminous strip-mine spoils in Pennsylvania.** Res. Comm. Coal Mine Spoil Revegetation Pa. (Rev. 1971). 46 p.

406. Davis, Grant, ed.
1973. **Comparison of fall and spring planting on strip-mine spoils in the bituminous regions of Pennsylvania.** *In* Ecology and reclamation of devastated land, Vol. I. Gordon & Breach, New York. p. 525-538.

407. Davis, Grant.
[1974] **Team approach to watershed ecosystem analysis.** Univ. Ky. Symp. on Use of Small Watersheds in Determining Eff. of For. Land Use on Water Qual. Proc. 1973. p. 79-82.

408. Davis Grant, and Walter H. Davidson.
1968. **Coal-mine spoil banks offer good potential for timber and wildlife production.** Pa. For. 58:20-21.

409. Davis, Hugh C.
1971. **The recreation-resource inventory process for state and regional plans.** *In* Recreation symp. proc. USDA For. Serv. Northeast. For. Exp. Stn. p. 1-4.

410. DeBald, Paul S., and David A. Gansner.
1966. **Kentucky forests: Eastern Unit.** USDA For. Serv. Resour. Bull. CS-4. 34 p. [Discontinued series.]

411. DeBald, Paul S., and Roger E. McCay.
1969. **The timber resources of the Ohio hill country.** USDA For. Serv. Resour. Bull. NE-14. 73 p.

412. DeBald, Paul S., and Joseph J. Mendel.
1971. **Determining the rate of value increase for oaks.** *In* Oak symp. proc. USDA For. Serv. Northeast. For. Exp. Stn. p. 142-151.

413. DeBald, Paul S., and Joseph J. Mendel.
1976. **An individual-tree approach to making stand evaluations.** SETs: Stand Evaluation Tools 1. USDA For. Serv. Res. Pap. NE-336. 13 p.

414. DeBald, Paul S., and Joseph J. Mendel.
1976. **Composite volume and value tables for hardwood pulpwood.** SETs: Stand Evaluation Tools 3. USDA For. Serv. Res. Pap. NE-338. 43 p.

415. DeGraaf, Richard M.
1975. **Wildlife considerations in metropolitan environments.** *In* Forestry issues in urban America. Proc. Soc. Am. For. 1974. p. 97-102.

416. DeGraaf, R. M., and J. S. Larson.
1972. **A technique for the observation of sex chromatin in hair roots.** J. Mammal. 53:368-371.

417. DeGraaf, Richard M., and Brian R. Payne.
1975. **Economic values of non-game birds and some urban wildlife reasearch needs.** *In* Transactions of the 40th North American wildlife and natural resources conference. p. 281-287.

418. DeGraaf, Richard M., H. Ross Pywell, and Jack Ward Thomas.
1975. **Relationships between nest height, vegetation, and housing density in New England suburbs.** Trans. Northeast Sect. Wildl. Soc. Northeast Fish Wildl. Conf. p. 131-150.

419. DeGraaf, Richard M., and Jack Ward Thomas.
1973. **A strategy for wildlife research in the city: the Forest Service program.** Trans. Northeast Sect. Wildl. Soc. Northeast Fish Wildl. Conf. 29. p. 29-44.

420. DeGraaf, Richard M., and Jack Ward Thomas.
1974. **A banquet for the birds.** Nat. Hist. 83(1):40-45.

421. DeGraaf, Richard M., and Jack Ward Thomas.
1974. **A strategy for wildlife research in urban areas.** *In* Wildlife in an urbanizing environment. Univ. Mass. Holdsworth Nat. Resour. Cent. Plann. and Dev. Ser. 28. p. 53-56.

422. DeGraaf, Richard M., and Jack Ward Thomas.
1974. **Toward nongame management.** Mass. Wildl. 25(1):14-15.

423. DeMars, C. J., Jr.
1969. **Quality control in entomological sampling.** (Abstr.) *In* Forest insect population dynamics. USDA For. Serv. Res. Pap. NE-125. p. 97-99.

424. Demeritt, M. E., Jr.
1973. **Prospects for selecting and breeding trees resistant to deicing salt.** 20th Northeast. For. Tree Improv. Conf. Proc. p. 130-140.

425. Demeritt, M. E., Jr., W. M. Chang, J. D. Murphy, and H. D. Gerhold.
1972. **Selection system for evaluating resistance of scotch pine seedlings to ozone and sulfur dioxide.** 19th Northeast. For. Tree Improv. Conf. Proc. p. 87-97.

426. Demeritt, M. E., Jr., H. D. Gerhold, and E. H. Palpant.
1975. **Genetic evaluation of two-year height of Scotch pine seedlings.** 22nd Northeast. For. Tree Improv. Conf. Proc. p. 148-158.

427. Demeritt, M. E., Jr., and H. W. Hocker, Jr.
1975. **Influence of seed weight on early development of eastern white pine.** 22nd Northeast. For. Tree Improv. Conf. Proc. p. 130-137.

428. Demeritt, Maurice E., Jr., and Harry C. Kettlewood.
1976. **Eastern white pine seed source variation in the Northeastern United States: 16-year results.** *In* Proceedings of the 12th Lake States forest tree improvement conference 1975. USDA For. Serv. Gen. Tech. Rep. NC-26. p. 80-87.

429. Dempsey, Gilbert P.
1966. **A review of forest-based cooperatives.** *In* Forest cooperatives: USDA workshop proceedings. U.S. Dep. Agric. Misc. Unnumbered Publ. p. 49-62.

430. Dempsey, Gilbert P.
1967. **Forest cooperatives: A bibliography.** USDA For. Serv. Res. Pap. NE-82. 53 p.

431. Dempsey, Gilbert P.
1968. **Some new guidelines for the forest cooperative.** J. For. 66:17-21.

432. Dempsey, Gilbert P.
1973. **Toward growth in productivity.** For. Prod. J. 23(4):12-14.

433. Dempsey, Gilbert P., and Clyde B. Markeson.
1969. **Guidelines for establishing forestry cooperatives.** USDA For Serv. Res. Pap. NE-133. 38 p.

434. Despard, Thomas L.
1974. **Avoid problem spoils through overburden analysis.** USDA For. Serv. Gen. Tech. Rep. NE-10. 4 p.

435. Dessureault, M., A. E. Rich, and A. L. Shigo.
1973. **Mapping of total nitrogen in decayed wood associated with *Fomes connatus* and *Polyporus glomeratus* in Acer rubrum.** (Abstr.) Phytopathology 63:200-201.

436. Dickson, David R., and Teresa M. Bowers.
1976. **Forest statistics for Connecticut.** USDA For. Serv. Resour. Bull. NE-44. 40 p.

437. Dirr, Michael A.
1976. **Salts and woody-plant interactions in the urban environment.** *In* Better trees for metropolitan landscapes symp. proc. USDA For. Serv. Gen. Tech. Rep. NE-22. p. 103-111.

438. Dissmeyer, George E., E. S. Corbett, and W. T. Swank.
1975. **Summary of municipal watershed management surveys in the eastern United States.** *In* Municipal watershed management symp. proc. USDA For. Serv. Gen. Tech. Rep. NE-13. p. 185-192.

439. Dochinger, L. S.
1969. ***Agrobacterium* gall of hybrid poplar trees in Iowa.** (Abstr.) Phytopathology 59:1024.

440. Dochinger, L. S.
1968. **Chlorotic dwarf of eastern white pine: Symptoms, etiology, and control.** (Abstr.) Phytopathology 58:1048.

441. Dochinger, L. S.
1968. **The impact of air pollution on eastern white pine: The chlorotic dwarf disease.** (Abstr.) J. Air Pollut. Control Assoc. Proc. Dig. 61:189.

442. Dochinger, L. S.
1970. **The impact of air pollution on eastern white pine—The chlorotic dwarf disease.** (Abstr.) Dok. Reinhaltung der Luft 1(5):210.

443. Dochinger, L. S.
1972. **Impact of air pollution on forest tree plantings.** Proc. 27th Annu. Meet. Soil Conserv. Soc. Am. p. 134-138.

444. Dockinger, L.S.
1976. **Acid rain leaching and other aspects of acid precipitation.** *In* Air pollution and metropolitan woody vegetation. USDA For. Serv. Pinchot Inst. Environ. For. Stud. p. 25-36.

445. Dochinger, L. S.
1976. **Cultural. [Approaches for reducing air-pollution damage.]** *In* Air pollution and metropolitan woody vegetation. USDA For. Serv. Pinchot Inst. Environ. For. Stud. p. 43-45.

446. Dochinger, Leon S.
1967. **Chlorotic dwarf of white pine: A problem of air pollution.** Ohio Woodlands 5(4):18-19.

447. Dochinger, Leon S.
1967. **Leptographium root decline of eastern white pines.** (Abstr.) Phytopathology 57:809.

448. Dochinger, Leon S.
1967. **Occurrence of poplar cankers caused by *Fusarium solani* in Iowa.** Plant Dis. Rep. 51:900-903.

449. Dochinger, Leon S.
1968. **Chlorotic dwarf in eastern white pine.** USDA For. Serv. Northeast. Area, State and Priv. For. Nurserymen's Conf. Proc. 1967. p. 1-5.

450. Dochinger, Leon S.
1968. **The impact of air pollution on eastern white pine: The chlorotic dwarf disease.** J. Air Pollut. Control Assoc. 18:814-816.

451. Dochinger, Leon S.
1969. **A progress report on three problems in Ohio forest nurseries.** USDA For. Serv. Northeast. Area, State and Priv. For. Nurserymen's Conf. Proc. 20:62-69.

452. Dochinger, Leon S.
1970. **Air pollution and landscape plants.** Natl. Landscape Assoc. Tech. Notes L 10 Dec.:1-5.

453. Dochinger, Leon S.
1970. **The impact of air pollution on Christmas tree plantings.** Am. Christmas Tree J. 14(3):5-8.

454. Dochinger, Leon S.
1971. **The symptoms of air pollution injuries to broad-leaved forest trees.** *In* Methods for the identification and evaluation of air-pollutants injurious to forests. IUFRO Congr. 15 Sect. 24. p. 7-32.

455. Dochinger, Leon S.
1972. **Can trees cleanse the air of particulate pollutants?** Int. Shade Tree Conf. Proc. 48:45-48.

456. Dochinger, Leon S.
1973. **Christmas trees and air pollution.** Horticulture 51:40-42.

457. Dochinger, Leon S.
1974. **Air pollution problems in nurseries.** New Horizons. p. 1-5.

458. Dochinger, Leon S.
1974. **An assessment of air-pollution injury to American forests.** Sylwan 9:63-68.

459. Dochinger, Leon S.
1975. **Improving city air quality with trees.** *In* Forestry issues in urban America. Proc. Soc. Am. For. 1974. p. 113-120.

460. Dochinger, Leon S.
1975. **Marssonina leaf blight of bigtooth aspen.** *Marssonina populi* **(Lib.) Magn.** *Drepanopeziza populorum* **Desm.)) v. Hohnel.** U.S. Dep. Agric., Agric. Handb. 470. p. 95-98.

461. Dochinger, Leon S., and Frederick W. Bender.
1972. **Additional hybrid poplar hosts of Fusarium canker in Ohio.** Plant Dis. Rep. 56:523-524.

462. Dochinger, L. S., F. W. Bender, F. L. Fox, and W. W. Heck.
1970. **Chlorotic dwarf of eastern white pine caused by an ozone and sulphur dioxide interaction.** Nature 225(5231):476.

463. Dochinger, L. S., and W. W. Heck.
1969. **An ozone-sulfur dioxide synergism produces symptoms of chlorotic dwarf of eastern white pine.** (Abstr.) Phytopathology 59:399.

464. Dochinger, Leon S., and Keith F. Jensen.
1975. **Air pollution.** *In* Forest nursery diseases in the United States. U.S. Dep. Agric., Agric. Handb. 470. p. 107-113.

465. Dochinger, Leon S., and Keith F. Jensen.
1975. **Effects of chronic and acute exposure to sulphur dioxide on the growth of hybrid poplar cuttings.** Environ. Pollut. 9:219-229.

466. Dochinger, Leon S., and Thomas A. Seliga.
1975. **Acid precipitation and the forest ecosystem.** J. Air Pollut. Control Assoc. 25:1103-1105.

467. Dochinger, Leon S., and Thomas A. Seliga.
1976. **Acid precipitation and the forest ecosystem.** BioScience 26:564-565.

468. Dochinger, L. S., and T. A. Seliga.
1976. **Proceedings of the first international symposium on acid precipitation and the forest ecosystem.** USDA For. Serv. Gen. Tech. Rep. NE-23. 1,074 p.

469. Dochinger, Leon S., and Thomas A. Seliga.
1976. **Workshop report on acid precipitation and the forest ecosystem.** USDA For. Serv. Gen. Tech. Rep. NE-26. 18 p.

470. Dochinger, Leon S., and Carl E. Seliskar.
1970. **Air pollution and the chlorotic dwarf disease of eastern white pine.** For. Sci. 16:46-55.

471. Dochinger, L. S., and W. H. Smith.
1976. **Gases.** *In* Air pollution and metropolitan woody vegetation. USDA For. Serv. Pinchot Inst. Environ. For. Stud. p. 51-52.

472. Dochinger, Leon S., Alden M. Townsend, and Donald W. Seegrist.
1971. **Responses of hybrid poplar trees to sulfur dioxide fumigation.** (Abstr.) Air Pollut. Control Assoc. Proc. 64:101.

473. Dochinger, Leon S., Alden M. Townsend, Donald W. Seegrist, and Frederick W. Bender.
1972. **Responses of hybrid poplar trees to sulfur dioxide fumigation.** J. Air Pollut. Control Assoc. 22:369-371.

474. Dodd, Steven J.
1966. **Utilization of conveyors in the wood industry.** *In* Forest engineering symp. proc. W. Va. Univ. Tech. Bull. 82. p. 100-103.

475. Dolby, A. J.
1975. **The disposal of discarded railroad wood crossties: A study of alternatives.** Assoc. Am. Rail Res. and Test. Dep. 38 p.

476. Donley, David E.
1967. **Distribution of Bidrin in the foliage of treated trees.** J. Econ. Entomol. 60:1583-1585.

477. Donley, David E.
1969. **Oviposition behavior of** *Goes tigrinus* **DeG. in white oak** *(Quercus*

alba L.). (Abstr.) Proc. North Cent. Branch Entomol. Soc. Am. 24:39.

478. Donley, David E.
1971. **Track the hickory nut weevil.** Ohio Woodlands 9(4):13.

479. Donley, David E.
1971. **Tuliptree scale damages Pennsylvania yellow-poplar.** Pa. For. 61:40-41.

480. Donley, David E.
1973. **The European pine shoot moth: 10 years later.** Ohio Woodlands 11(3):18-20.

481. Donley, David E.
1974. **Wood borer losses in Appalachian oak.** South. Lumberman 229 (2848):115-116, 118.

482. Donley, D. E., and D. P. Burns.
1966. **Dispersal of the tuliptree scale.** (Abstr.) Ecol. Soc. Am. Bull. 47:153.

483. Donley, D. E., and D. P. Burns.
1967. **The foraging behavior of the honeydew-seeking ant, *Dolichoderus taschenbergi* Mayr.** Ecol. Soc. Am. Bull. 48:65-66.

484. Donley, D. E., and D. P. Burns.
1968. **Factors regulating populations of the tuliptree scale.** (Abstr.) Entomol. Soc. Am. Bull 14:211.

485. Donley, D. E., C. J. Hay, and D. P. Burns.
1969. **Borers in Ohio oaks.** Ohio Woodlands 7(4):17-18.

486. Donley, David E., C. J. Hay, and J. R. Galford.
1974. **Wood borer impact on Ohio oak.** Ohio Woodlands 12(2):4-5,14.

487. Donley, David E., and David P. Worley.
1976. **Insect impact on production of oak timber.** South. Lumberman 233(2896):63-66.

488. Donnelly, John R.
1971. **Individual tree differences confound effects of growth regulators in rooting sugar maple softwood cuttings.** USDA For. Serv. Res. Note NE-129. 6 p.

489. Donnelly, John R.
1974. **Shoot size significantly affects rooting response of sugar maple softwood cuttings.** USDA For. Serv. Res. Note NE-184. 4 p.

490. Donnelly, John R.
1976. **Carbohydrate levels in current-year shoots of sugar maple.** USDA For. Serv. Res. Pap. NE-347. 6 p.

491. Donnelly, John R., and Harry W. Yawney.
[1973] **Some factors associated with vegetatively propagating sugar maple by stem cuttings.** Int. Plant Propag. Soc. Proc. 22:413-430.

492. Donohoe, Robert W.
1974. **American hornbeam.** *In* Shrubs and vines for northeastern wildlife. USDA For. Serv. Gen. Tech. Rep. NE-9. p. 86-88.

493. Donohoe, Robert W.
1974. **Sweet crab apple.** *In* Shrubs and vines for northeastern wildlife. USDA For. Serv. Gen. Tech. Rep. NE-9. 29-31.

494. Doolittle, Warren T.
1966. **Some implications of even-aged management in the production of Appalachian hardwoods.** For. Prod. J. 16:25-28.

495. Doolittle, Warren T.
1967. **Space-age timber management: Silviculture.** N. Engl. Sect. Soc. Am. For. News Q., April. p. 11-15.

496. Doolittle, Warren T.
1969. **Research in urban forestry.** Soc. Am. For. Annu. Meet. (1968) Abstr. Pap. 10.

497. Doolittle, Warren T.
1969. **Productivity of forest land for tree growth.** Soc. Am. For. Annu. Meet. (1968) Abstr. Pap. 32.

498. Doolittle, Warren T.
1969. **Research in urban forestry.** J. For. 67:650,652,656.

499. Doolittle, Warren T.
1970. **A new role for the Pinchot Institute.** Pa. For. 60: 81.

500. Doolittle, Warren T.
1971. **Tree improvement and environmental forestry.** 18th Northeast. For. Tree Improv. Conf. Proc. p. 65-69.

501. Doolittle, Warren T.
1973. **Opening remarks on behalf of the U.S. Forest Service.** *In* Forest fertilization symp. proc. USDA For. Serv. Gen. Tech. Rep. NE-3. p. 1-2.

502. Doolittle, W. T.
1973. **The hardwood futures: A look at the resource and management.** Proc. 1st Annu. Hardwood Symp. Hardwood Res. Counc. p. 22-29.

503. Doolittle, W. T.
[1974] **Some thoughts on the nature of watershed research needed for environmental policy decisions.** Univ. Ky. Symp. on Use of Small Watersheds in Determining Eff. of For. Land Use on Water Qual. Proc. 1973. p. 83-87.

504. Dorn, Donald E., and L. R. Auchmoody.
1974. **Progress report: Effects of fertilization on vegetative growth and early flowering and fruiting of seed orchard black cherry.** 21st Northeast. For. Tree Improv. Conf. Proc. p. 6-18.

505. Dorn, Donald E., and L. R. Auchmoody.
1974. **Scheduling timber cutting for sustained yield of wood products and wildlife.** *In* University of Missouri timber-wildlife management symp. proc. Mo. Acad. Sci. Occas. Pap. 30. p. 33-43.

506. Dorn, Donald, and Virgil Flick.
1969. **Seed cleaning equipment for removing pulp from black cherry.** Tree Plant. Notes 20(3):11-12.

507. Dorrell, Frederick A.
1971. **Multiple-use management of upland hardwood forests.** *In* Oak symp. proc. USDA For. Serv. Northeast. For. Exp. Stn. p. 159-161.

508. Doshi, Yobesh K.
1976. **Design of a digitally controlled environmental chamber for air pollution effects studies on plants.** Atmos. Sci. Program Rep. EES.

509. Doskotch, Raymond W., Sujit K. Chatterji, and John W. Peacock.
1970. **Elm bark derived feeding stimulants for the smaller European elm bark beetle.** Science 167:380-382.

510. Doskotch, Raymond W., Adel A. Mikhail, and Sujit K. Chatterji.
1973. **Structure of the water-soluble feeding stimulant for** *Scolytus multistriatus:* **A revision.** Phytochemistry 12:1153-1155.

511. Douglass, James E., and Wayne T. Swank.
1975. **Effects of management practices on water quality and quantity: Coweeta Hydrologic Laboratory, North Carolina.** *In* Municipal watershed management symp. proc. USDA For. Serv. Gen. Tech. Rep. NE-13. p. 1-13.

512. Drnevich, V. P., R. J. Ebelhar, and G. P. Williams.
1976. **Geotechnical properties of some eastern Kentucky surface mine spoils.** *In* Proc. Ohio River Valley soils seminar. Shales and mine waste: Geotechnical properties, design and construction. Lexington, Ky. p. 1-1/1-13.

513. Drnevich, V. P., G. P. Williams, and R. J. Ebelhar.
1976. **Soil mechanics tests on coal mine spoils.** *In* Proc. 2nd Kentucky coal refuse disposal and utilization seminar. Inst. Min. Miner., Lexington. p. 47-59.

514. Drooz, A. T.
1969. **Population density and insect biology: A review.** *In* Forest insect population dynamics. USDA For. Serv. Res. Pap. NE-125. p. 113-126.

515. Dubois, Normand R.
1968. **Laboratory batch production of** *Bacillus thuringiensis* **spores and crystals.** Appl. Microbiol. 16:1098-1099.

516. Dubois, Normand R.
1976. **Effectiveness of chemically decontaminated** *Neodiprion sertifer* **polyhedral inclusion body suspensions.** J. Econ. Entomol. 69:93-95.

517. Dubois, Normand R., and Alan H. Squires.
1971. **The determination of the relative virulence of** *Bacillus thuringiensis* **and related crystalliferous bacteria against gypsy moth larvae** *Porthetria dispar* **(L.))** 4th Int. Colloq. Insect Pathol. p. 196-208.

518. Dudley, Theodore R.
1976. **How to name, register, and patent selected cultivars of amenity plants.** *In* Better trees for metropolitan landscapes symp. proc. USDA For. Serv. Gen. Tech. Rep. NE-22. p. 235-243.

519. Dunmire, Daniel E.
1971. **Predicting yields from Appalachian red oak logs and lumber.** *In* Oak symp. proc. USDA For. Serv. Northeast. For. Exp. Stn. p. 94-99.

520. Dunmire, Daniel E., Robert L. Brisbin, and Ronald Gale.
1974. **Furniture square yields from graded maple bolts.** Proc. 2nd Annu. Hardwood Symp. Hardwood Res. Counc. p. 129-141.

521. Eabry, Steve.
1974. **Mountain-ashes.** *In* Shrubs and vines for northeastern wildlife. USDA For. Serv. Gen. Tech. Rep. NE-9. p. 98-101.

522. Eads, L. D.
1967. **Furniture species: A forecast of tomorrow's trends.** For. Prod. J. 17(8):10-11.

523. Eads, Larry D.
1967. **Furniture species: Yesterday, today, and tomorrow.** Upholstering Ind. 34(4):8,10,39-40,43,45-49.

524. Echelberger, H. E.
1974. **Timber management and aesthetics: A dilemma.** N.Y. For. 31(2):21-23.

525. Echelberger, Herbert E.
1971. **Vegetative changes at Adirondack campgrounds, 1964 to 1969.** USDA For. Serv. Res. Note NE-142. 8 p.

526. Echelberger, Herbert E.
1974. **Environmental perception and urban forestry.** Univ. Wis. Urban For. Conf. Proc. p. 17-28.

527. Echelberger, Herbert E.
1974. **Poor "promotion-itis"?** J. Travel Res. 12(3):5-6.

528. Echelberger, Herbert E.
1976. **Impacts of logging. Part 3: Public relations.** North. Logger 25(2):9.

529. Echelberger, Herbert E., Daniel H. Deiss, and Douglas A. Morrison.
1974. **Overuse of unique recreation areas: A look at the social problems.** J. Soil & Water Conserv. 29:173-178.

530. Echelberger, Herbert E., and George H. Moeller.
1973. **Toward a better understanding of recreational boating in the Adirondack Lakes Region.** Water Resour. Bull. 9:1266-1272.

531. Echelberger, Herbert E., George H. Moeller, and Raymond E. Leonard.
1975. **Recreation problems and opportunities.** *In* Municipal watershed management symp. proc. USDA For. Serv. Gen. Tech. Rep. NE-13. p. 154-161.

532. Echelberger, Herbert E., and Elwood L. Shafer, Jr.
1968. **Some managers' viewpoints on campers and campground operation.** USDA For. Serv. Res. Note NE-88. 6 p.

533. Echelberger, Herbert E., and Elwood L. Shafer, Jr.
1970. **Snow + (X) = Use of ski slopes.** J. Mark. Res. 7:388-392.

534. Echelberger, Herbert E., and Elwood L. Shafer, Jr.
1970. **Some managers' viewpoints on campers and campground operation.** Park Practice Guidline. Dec. Adm. 44. 4 p.

535. Egolf, Donald R.
1976. **The national arboretum introduction program for new and improved shrubs and trees.** *In* Better trees for metropolitan landscapes symp. proc. USDA For. Serv. Gen. Tech. Rep. NE-22. p. 245-252.

536. Ellefson, Paul V.
1966. **Marketing Research at the Forest Products Marketing Laboratory.** Am. Christmas Tree J. 10(4):16.

537. Ellefson, Paul V.
1966. **Our maladjusted crosstie market: What's ahead?** Prog. Railroading 9(6):45-49.

538. Ellefson, Paul V.
1967. **Christmas tree marketing: A bibliography.** Am. Christmas Tree J. 11(2):15-25.

539. Ellefson, Paul V., and Gilbert P. Dempsey.
1969. **Promotion: A step toward sound Christmas tree marketing.** Am. Christmas Tree J. 13(3):49-53.

540. Ellefson, Paul, and Harold W. Wisdom.
1967. **Present costs determine future Christmas tree profits.** Am. Christmas Tree J. 11(2):9-13.

541. Ellis, R. C., and F. W. von Althen.
1973. **Fertilization of adult and juvenile hardwoods in Ontario.** *In* Forest fertilization symp. proc. USDA For. Serv. Gen. Tech. Rep. NE-3. p. 174-182.

542. Emanuael, David M.
1971. **Power mulchers can apply hardwood bark mulch.** USDA For. Serv. Res. Note NE-135. 6 p.

543. Emanuael, David M.
1976. **Hydromulch: A potential use for hardwood bark residue.** USDA For. Serv. Res. Note NE-226. 3 p.

544. Eschner, A. R., and R. E. Leonard.
1968. **Disposition of intercepted snow.** East. Snow Conf. Proc. 25:73-81.

545. Eschner, A. R., R. E. Leonard, and A. L. Leaf.
1969. **Soil moisture priming, soil temperature and water available for snowmelt runoff.** East. Snow Conf. Proc. 26:19-25.

546. Eschner, Arthur R., and Donald L. Mader.
1975. **Management implications of other hydrologic research in the Northeast.** *In* USDA For. Serv. Gen. Tech. Rep. NE-13. p. 66-78.

547. Eschner, A. R., and D. R. Satterlund.
1966. **Forest protection and streamflow from an Adirondack watershed.** Water Resour. Res. 2:765-783.

548. Fabos, Julius Gy.
1971. **An analysis of environmental quality ranking systems.** *In* Recreation symp. proc. USDA For. Serv. Northeast For. Exp. Stn. p. 40-55.

549. Fay, Stephen.
1975. **Ground-cover vegetation management at backcountry recreation sites.** USDA For. Serv. Res. Note NE-201. 5 p.

550. Fay, Stephen, and R. E. Leonard.
1974. **Back-country research in the Northeast.** Maine For. Rev. 5:16.

551. Federer, C. A.
1968. **Radiation and snowmelt on a clearcut watershed.** East. Snow Conf. Proc. 25:28-42.

552. Federer, C. A.
1968. **Spatial variation of net radiation, albedo, and surface temperature of forests.** J. Appl. Meteorol. 7:789-795.

553. Federer, C. A.
1969. **New landmark in the White Mountains.** Appalachia 37:586-594.

554. Federer, C. A.
1969. **Reduction of summer city temperatures by trees.** Soc. Am. For. Annu. Meet. (1968) Abstr. Pap. 27.

555. Federer, C. A.
1971. **Effects of trees in modifying the urban microclimate.** *In* Symp. on trees and forests in an urbanizing environment. Univ. Mass. Coop. Ext. Serv. p. 23-28.

556. Federer, C. A.
1971. **Solar radiation absorption by leafless hardwood forests.** Agric. Meteorol. 9(6):3-20.

557. Federer, C. A.
1973. **Forest transpiration greatly speeds streamflow recession.** Water Resour. Res. 9:1599-1604.

558. Federer, C. A.
1975. **Evapotranspiration.** Rev. Geophys. and Space Phys. 13:(3)442-445, 487-494.

559. Federer, C. A.
1976. **Differing diffusive resistance and leaf development may cause differing transpiration among hardwoods in spring.** For. Sci. 22:359-364.

560. Federer, C. A.
1976. **Review of "Vegetation and the atmosphere, vol. 1, principles," edited by J. L. Monteith.** Am. Meteorol. Soc. Bull. 57:1161-1162.

561. Federer, C. A.
1976. **Stomatal resistance characteristics for broadleaved trees and shrubs. (Abstr.)** Am. Meteorol. Soc. Bull. 56:109.

562. Federer, C. A.
1976. **Trees modify the urban microclimate.** J. Arboric. 2:121-127.

563. Federer, C. Anthony.
1967. **New radiation instruments.** *In* International symp. on forest hydrology proc. Pergamon Press, Oxford, England. p. 801-805.

564. Federer, C. Anthony. —
1970. **Measuring forest evapotranspiration: Theory and problems.** USDA For. Serv. Res. Pap. NE-165. 25 p.

565. Federer, C. Anthony.
1970. **Review of "Climate and agriculture: An ecological survey," by Jen-hu Chang.** Am. Meteorol. Soc. Bull. 51:439-440.

566. Federer, C. Anthony.
1972. **Review of "Problems and methods in argicultural climatology," by Jen-hu Chang.** Am. Meteorol. Soc. Bull. 53:271-272.

567. Federer, C. Anthony.
1973. **Annual cycles of soil and water temperatures at Hubbard Brook.** USDA For. Serv. Res. Note NE-167. 7 p.

568. Federer, C. Anthony.
1975. **Decisions: Why, what, when, where, and how to measure treatment-induced changes in physical variances.** *In* Symp. monitoring forest environment through successive sampling proc. SUNY Coll. Environ. Sci. and For., Syracuse. p. 253-265.

569. Federer, C. A., and G. W. Gee.
1972. **Stomatal resistance of hardwoods during leafout and leaffall periods. (Abstr.)** Am. Meteorol. Soc. Bull. 53:1029.

570. Federer, C. A., and G. W. Gee.
1974. **Diffusion resistance and xylem potential in stressed and unstressed northern hardwood trees.** Agron. Abstr. p. 11.

571. Federer, C. A., and G. W. Gee.
1976. **Diffusion resistance and xylem potential in stressed and unstressed northern hardwood trees.** Ecology 57:975-984.

572. Federer, C. Anthony, and Glendon W. Gee.
1974. **Tree water stress in relation to water yield in a hardwood forest.** Univ. N.H. Water Resour. Res. Cent. Res. Rep. 7. 30 p.

573. Federer, C. A., and R. E. Leonard.
1971. **Snowmelt in hardwood forests.** East. Snow Conf. Proc. 28:95-109.

574. Federer, C. Anthony, Robert S. Pierce, and James W. Hornbeck.
1972. **Snow management seems unlikely in the Northeast.** *In* Watersheds in transition. Am. Water Resour. Assoc. Symp. p. 212-219.

575. Federer, C. A., and C. B. Tanner.
1966. **Sensors for measuring light available for photosynthesis.** Ecology 47:654-657.

576. Federer, C. A., and C. B. Tanner.
1966. **Spectral distribution of light in the forest.** Ecology 47:555-560.

577. Ferguson, Roland H.
1967. **The timber resources of Maryland.** USDA For. Serv. Resour. Bull. NE-7. 93 p.

578. Ferguson, Roland H.
1968. **The timber resources of Pennsylvania.** USDA For. Serv. Resour. Bull. NE-8. 147 p.

579. Ferguson, Roland H., and Neal P. Kingsley.
1972. **The timber resources of Maine.** USDA For. Serv. Resour. Bull. NE-26. 129 p.

580. Ferguson, Roland H., and Carl E. Mayer.
1970. **The timber resources of New York.** USDA For. Serv. Resour. Bull. NE-20. 193 p.

581. Ferguson, Roland H., and Carl E. Mayer.
1974. **The timber resources of Delaware.** USDA For. Serv. Resour. Bull. NE-32. 42 p.

582. Ferguson, Roland H., and Carl E. Mayer.
1974. **The timber resources of New Jersey.** USDA For. Serv. Resour. Bull. NE-34. 58 p.

583. Ffolliott, Peter F., and David P. Worley.
1973. **Forest stocking equations: Their development and application.** USDA For. Serv. Res. Pap. RM-102. 8 p.

584. Filip, Gregory M., A. L. Shigo, M. C. Hoyle, and A. E. Rich.
1973. **Effect of fertilizer salt accumulation and low relative humidity on development of stem lesions on yellow birch seedlings.** Plant Dis. Rep. 57:499.

585. Filip, Stanley M.
1967. **Harvesting costs and returns under 4 cutting methods to mature beech-birch-maple stands in New England.** USDA For. Serv. Res. Pap. NE-87. 14 p.

586. Filip, Stanley M.
1969. **Natural regeneration of birch in New England.** *In* Birch symp. proc. USDA For. Serv. Northeast. For. Exp. Stn. p. 50-54.

587. Filip, Stanley M.
1969. **Panel comments.** *In* Proceedings sugar maple conference, 1968. Mich. Tech. Univ., Houghton. p. 94

588. Filip, Stanley M.
1971. **An example of product yields from an even-aged northern hardwood stand in New Hampshire.** North. Logger 19(12):22-23.

589. Filip, Stanley M.
1973. **Cutting and cultural methods for managing northern hardwoods in the northeastern United States.** USDA For. Serv. Gen. Tech. Rep. NE-5. 8 p.

590. Filip, Stanley M., and W. B. Leak.
1973. **Northeastern northern hardwoods.** *In* Silvicultural systems for the major forest types of the United States. U.S. Dep. Agric., Agric. Handb. 445. p. 75-77.

591. Filip, Stanley M., and Elbert L. Little, Jr.
1971. **Trees and shrubs of the Bartlett Experimental Forest, Carroll County, New Hampshire.** USDA For. Serv. Res. Pap. NE-211. 20 p.

592. Filip, S. M., and N. D. Shirley.
1968. **Cost of site preparation with a tractor rake in northern hardwood clearcutting.** North. Logger 17(5): 18-19.

593. Filip, S. M., and F. W. Williams.
1968. **Volume and value of products harvested from a northern hardwood clearcutting.** North. Logger 17(4): 22-23.

594. Finnegan, R. J., and P. A. Godwin.
1967. **Northern pine weevil *Pissodes approximatus* Hopk.** *In* Important forest insects and diseases of mutual concern to Canada, the United States and Mexico. Can. Dep. For. Rural Dev. Publ. 1180. p. 145-147.

595. Fisher, Edward L., and Harry G. Gibson.
1976. **Helicopter logging moves east: Trial results.** Am. Soc. Agric. Eng. Winter Meet. Pap. 76-1565. 7 p.

596. Flemer, William, III.
1976. **Container trees for use in landscaping.** *In* Better trees for metropolitan landscapes symp. proc. USDA For. Serv. Gen. Tech. Rep. NE-22. p. 185-193.

597. Fortescue, J. A. C., and D. Burger.
1973. **Landscape geochemistry and forest fertilization.** *In* Forest fertilization symp. proc. USDA For. Serv. Gen. Tech. Rep. NE-3. p. 226-233.

598. Frank, Robert M.
1968. **Clearcutting in spruce-fir: Today and tomorrow.** Proc. Annu. Winter Meet. New Engl. Sect. Soc. Am. For. p. 28-35.

599. Frank, Robert M.
1973. **The course of growth response in released white spruce: 10-year results.** USDA For. Serv. Res. Pap. NE-258. 6 p.

600. Frank, Robert M.
1974. **Options for and probable benefits of timber stand improvement in Maine.** Maine For. Rev. 6:2-4.

601. Frank, Robert M.
1975. **Big balsam fir trees are hard to find: Is there a bigger one in Maine?** Maine For. Rev. 8:2.

602. Frank, Robert M., and John C. Bjorkbom.

1973. **A silvicultural guide for spruce-fir in the Northeast.** USDA For. Serv. Gen. Tech. Rep. NE-6. 29 p.

603. Frank, Robert M., and Eugene L. Putnam.
1972. **Seedling survival in spruce-fir after mechanical tree harvesting in strips.** USDA For. Serv. Res. Pap. NE-224. 16 p.

604. Frank, Robert M., and Lawrence O. Safford.
1970. **Lack of viable seeds in the forest floor after clearcutting.** J. For. 68:776-778.

605. Frayer, Warren E.
1966. **Weighted regression in successive forest inventories.** For. Sci. 12:464-472.

606. Frayer, Warren E.
1967. **A systematic bias in the interpretation of CFI results.** USDA For. Serv. Res. Note NE-60. 4 p.

607. Frayer, Warren E.
1968. **A computer program for making S-contrasts involving linear combinations of group means.** USDA For. Serv. Res. Note NE-80. 6 p.

608. Frayer, Warren E.
1968. **SNOOP: A computer program for 2- and 3-dimensional plotting.** USDA For. Serv. Res. Pap. NE-91. 24 p.

609. Frayer, Warren E., and Joseph E. Barnard.
1966. **Average growth rates in southern Maine.** USDA For. Serv. Res. Note NE-47. 8 p.

610. Frayer, W. E., and J. E. Barnard.
1974. **Experience with sampling with partial replacement in the United States.** *In* IUFRO subject group S-4.02. June 1973 proc. vol. 2. 4 p.

611. Frayer, Warren E., and George M. Furnival.
1967. **Area change estimates from sampling with partial replacement.** For. Sci. 13:72-76.

612. Frayer, Warren E., R. W. Wilson, and G. M. Furnival.
1971. **FSCREEN (fast screen), a computer program for screening all combinations of independent variables in univariate multiple linear regressions.** Colo. State Univ. Dep. For. and Wood Sci., Fort Collins. 23 p.

613. Frayer, Warren E., Robert W. Wilson, Robert C. Peters, and C. Allen Bickford.
1968. **FINSYS: An efficient data-processing system for large forest inventories.** J. For. 66:902-905.

614. Freeman, Wilfred L., Jr., Leon S. Dochinger, and Robert C. Doerner.
1971. **Forest Service research and action programs for abatement of air pollution.** South. Lumberman 223(2776):87-89.

615. Fridrich, James H., Avery E. Rich, and Alex L. Shigo.
1971. **Fungi isolated from fruits and seeds of some northern hardwood trees.** Rhodora 73:306-308.

616. Frost, Richard E., and Hollis R. Large.
1975. **Pallet repair and salvage.** USDA For. Serv. Res. Pap. NE-323. 7 p.

617. Fulton, John R.
1974. **Pin cherry.** *In* Shrubs and vines for northeastern wildlife. USDA For. Serv. Gen. Tech. Rep. NE-9. p.26-28.

618. Furnival, G. M., and R. W. Wilson, Jr.
1971. **Systems of equations for predicting forest growth and yield.** Statist. Ecol. 3:43-55.

619. Furnival, George M., and Robert W. Wilson, Jr.
1974. **Regression by leaps and bounds.** Technometrics 16:499-511.

620. Gabriel, William J.
1966. **The onset and duration of stigma receptivity in sugar maple flowers.** For. Sci. 12:14-18.

621. Gabriel, William J.
1967. **Reproductive behavior in sugar maple: Self-compatibility, cross-compatibility, agamospermy, and agamocarpy.** Silvae Genet. 16(5-6):165-168.

622. Gabriel, William J.
1968. **Dichogamy in *Acer saccharum*.** Bot. Gaz. 129:334-338.

623. Gabriel, William J.
1969. **Mass testing for sap sugar concentration in sugar maple seelings.** 16th Northeast. For. Tree Improv. Conf. Proc. p. 25-26.

624. Gabriel, William J.
1969. **The search for sweet sugar maples.** Natl. Maple Syrup Dig. 8(1):8.

625. Gabriel, William J.
1970. **Initiation and development of floral primordia in sugar maple. (Abstr.)** 1st North Am. For. Biol. Workshop. Mich. State Univ., East Lansing.

626. Gabriel, William J.
1972. **One-parent progeny test of sugar maples selected for superior sap-sugar production: Early results.** 19th Northeast. For. Tree Improv. Conf. Proc. p. 12-16.

627. Gabriel, William J.
1972. **Phenotypic selection in sugar maple for superior sap sugar production.** USDA For. Serv. Res. Pap. NE-221. 12 p.

628. Gabriel, William J.
1972. **Selection and propagation of superior sap sugar-producing trees.** Proc. 8th Conf. Maple Prod. ARS 73-73 (EMN Publ. 3618). p. 3-9.

629. Gabriel, William J.
1973. **Morphological differences between black maple and sugar maple and their hybrids.** 20th Northeast. For. Tree Improv. Conf. Proc. p. 39-45.

630. Gabriel, William J.
1974. **Phenotypic selection of sugar maples for superior sap volume production.** 21st Northeast. For. Tree Improv. Conf. Proc. p. 19-26.

631. Gabriel, William J.
1974. **A search for superior maples.** Natl. Maple Syrup Dig. 13(1):16-17.

632. Gabriel, William J.
1975. **Allelopathic effects of black walnut on white birches.** J. For. 73:234-237.

633. Gabriel, W. J., and E. E. Howe.
1968. **Practical problems of a sugar maple selection program.** 15th Northeast. For. Tree Improv. Conf. Proc. p. 72-74.

634. Gabriel, William J., H. Cedric Larrson, and Howard B. Kriebel.
[1967] **Hardwood forest tree improvement research in eastern United States and southeastern Canada.** Northeast. For. Tree Improv. Conf. Comm. Rep. 22 p.

635. Gabriel, William J., Russell S. Walters, and Donald W. Seegrist.
1972. **The relationship between sap-flow rate and sap volume in dormant sugar maples.** USDA For. Serv. Res. Note NE-153. 4 p.

636. Gagnon, J. D.
1973. **Environmental aspects of sewage-derived fertilizers.** *In* Forest fertilization symp. proc. USDA For. Serv. Gen. Tech. Rep. NE-3. p. 101-107.

637. Galford, Jimmy R.
1967. **Emergence of *Entedon leucogramma* from smaller European elm bark beetle larvae reared on artificial media.** J. Econ. Entomol. 60: 1482-1483.

638. Galford, Jimmy R.
1967. **A technique for rearing larvae of the smaller European elm bark beetle on an artificial medium.** J. Econ. Entomol. 60:1192.

639. Galford, Jimmy R.
1969. **Artificial rearing of 10 species of wood-boring insects.** USDA For. Serv. Res. Note NE-102. 6 p.

640. Galford, Jimmy R.
1969. **A larval and ovipositional medium for the smaller European elm bark beetle.** J. Econ. Entomol. 62:1166-1168.

641. Galford, Jimmy R.
1971. **Improved techniques for rearing the smaller European elm bark beetle on artificial media.** J. Econ. Entomol. 64:1327-1328.

642. Galford, Jimmy R.
1972. **Some basic nutritional requirements of smaller European elm bark beetle larvae.** J. Econ. Entomol. 65:681-684.

643. Galford, Jimmy R.
1974. **Some physiological effects of temperature on artificially reared red oak borers.** J. Econ. Entomol. 67:709-710.

644. Galford, Jimmy R.
1975. **Red oak borers become sterile when reared under continuous light.**

USDA For. Serv. Res. Note NE-205. 2 p.

645. Galford, Jimmy R., and John W. Peacock.
1968. **Combined laboratory and greenhouse techniques for year-round rearing of the mimosa webworm,** *Homadaula anisocentra.* Ann. Entomol. Soc. Am. 61:919-920.

646. Galford, J. R., and L. R. Schreiber.
1972. **Effect of feeding on twigs from benomyl-treated seedlings on the smaller European elm bark beetle.** J. Econ. Entomol. 65:142.

647. Galoch E., and M. Michniewicz.
1976. **Comparison of the dynamics of endogenous growth regulators in the shoots of young pines** *(Pinus silvestris* **L.) being in the vegetative and generative stages of development.** Proc. 4th Plant Growth Regulators Symp. (Toŕun, Poland, 1974). p. 39-44.

648. Gambrell, S. C., Jr., and E. F. Byars.
1966. **Cutting characteristics of chain saw teeth.** For. Prod. J. 16(1):62-71.

649. Gammon, Glenn L.
1969. **Specific gravity and wood moisture variation of white pine.** USDA For. Serv. Res. Note NE-99. 6 p.

650. Gammon, Glenn L.
1971. **Volume loss and grade change of hardwood lumber during air-drying.** USDA For. Serv. Res. Pap. NE-227. 17 p.

651. Gansner, David A.
1966. **Timber resources of Missouri's northwestern Ozarks.** Univ. Mo. Agric. Exp. Stn. and USDA For. Serv. 51 p.

652. Gansner, David A.
1966. **Timber resources of Missouri's southwestern Ozarks.** Univ. Mo. Agric. Exp. Stn. and USDA For. Serv. 51 p.

653. Gansner, David A.
1967. **Consumption of residues rises to an all-time high.** Ohio Woodlands 5(4):14.

654. Gansner, David A.
1968. **The timber resources of Kentucky.** USDA For. Serv. Resour. Bull. NE-9. 97 p.

655. Gansner, David A., Joseph E. Barnard, and Samuel F. Gingrich.
1973. **Identifying regional opportunities for accelerated timber management.** USDA For. Serv. Res. Pap. NE-251. 6 p.

656. Gansner, David A., and Paul S. DeBald.
1966. **Kentucky forests: Northern Cumberland unit.** USDA For. Serv. Resour. Bull. CS-5. 37 p. [Discontinued series.]

657. Gansner, David A., and Paul S. DeBald.
1966. **Timber resources of Kentucky: Pennyroyal unit.** USDA For. Serv. Resour. Bull. CS-6. 46 p. [Discontinued series.]

658. Gansner, David A., and Paul S. DeBald.
1966. **Timber resources of Kentucky: Bluegrass unit.** USDA For. Serv. Resour. Bull. CS-7. 33 p. [Discontinued series.]

659. Gansner, David A., and Paul S. DeBald.
1966. **Timber resources of Kentucky: Western unit.** USDA For. Serv. Resour. Bull. CS-8. 34 p. [Discontinued series.]

660. Gansner, David A., and Burton L. Essex.
1966. **Timber resources of Missouri's riverborder region.** Univ. Mo. Agric. Exp. Stn. and USDA For. Serv. 73 p.

661. Gansner, David A., and Owen W. Herrick.
1973. **The timber-supply potential of intensive management in upland oak forests of Ohio.** USDA For. Serv. Res. Pap. NE-271. 8 p.

662. Gansner, David A., Owen W. Herrick, and David N. Larsen.
1973. **Deriving fair incentives for management of hardwood timber stands.** USDA For. Serv. Res. Pap. NE-263. 4 p.

663. Gansner, David A., and David N. Larsen.
1969. **Pitfalls of using internal rate of return to rank investments in forestry.** USDA For. Serv. Res. Note NE-106. 5 p.

664. Gansner, David A., Donald W. Seegrist, and Gerald S. Walton.
1971. **A technique for defining subareas for regional analysis.** Growth and Change 2(4):20-24.

665. Gansner, David A., and Edgar T. Shaudys.
1969. **Opportunities for pulpwood growing investment in southeastern Ohio.** USDA For. Serv. Res. Pap. NE-151. 24 p.

666. Gardescu, Paul.
1976. **A landscape architect's view of better trees for urban spaces.** *In* Better trees for metropolitan landscapes symp. proc. USDA For. Serv. Gen. Tech. Rep. NE-22. p. 135-142.

667. Garrett, David.
1974. **The energy crisis: What it means to you as a producer.** Natl. Maple Syrup Dig. 13(1):12-16.

668. Garrett, Lawrence D.
1969. **Economic implications of manufacturing sawed ties and timbers.** USDA For. Serv. Res. Pap. NE-148. 24 p.

669. Garrett, Lawrence D.
1970. **Physical suitability of Appalachian hardwood sawlogs for sawed timbers.** USDA For. Serv. Res. Note NE-121. 6 p.

670. Garrett, Lawrence D.
1971. **City fire codes become threat to natural Christmas tree sales.** Am. Christmas Tree J. 15(3):5-7.

671. Garrett, Lawrence D., Howard Duchacek, Frederick M. Laing, and James W. Marvin.
1975. **Test results of a maple sap preheater and modified oil burner arch with wood chips.** Natl. Maple Syrup Dig. 14(1):14-15.

672. Garrett, Peter.
1972. **Resistance of eastern white pine *(Pinus strobus* L.) provenances to the white pine weevil (*Pissodes strobi* Peck).** Silvae Genet. 21:119-121.

673. Garrett, Peter W.
1969. **Height growth and foliage color in a Scotch pine provenance study in northern Michigan.** USDA For. Serv. Res. Note NE-96. 7 p.

674. Garrett, Peter W.
1970. **Early evidence of weevil resistance in some clones and hybrids of white pine.** USDA For. Serv. Res. Note NE-117. 4 p.

675. Garrett, Peter W.
1973. **Dr. Ernst Jefferson Schreiner.** 20th Northeast. For. Tree Improv. Conf. Proc. p. 3-16.

676. Garrett, Peter W.
1973. **Northeastern Forest Tree Improvement Conference NEFTIC cumulative index vol. 1-20, 1953-1972.** USDA For. Serv. Northeast. For Exp. Stn. 73 p.

677. Garrett, Peter W., and H. C. Kettlewood.
1975. **Variations in juvenile oak.** USDA For. Serv. Res. Note NE-204. 4 p.

678. Garrett, P. W., and R. M. Rauter.
1973. **Geographic variation in resistance to white pine weevil *(Pissodes strobi* Peck.) by eastern white pine, *(Pinus strobus* L.).** Can. Entomol. 105:347-351.

679. Garrett, Peter W., Ernst J. Schreiner, and Harry Kettlewood.
1973. **Geographic variation of eastern white pine in the Northeast.** USDA For. Serv. Res. Pap. NE-274. 14 p.

680. Garrett, Peter W., and Robert Zahner.
1973. **Fascicle density and needle growth responses of red pine to water supply over two seasons.** Ecology 54:1328-1334.

681. Gatchell, Charles J.
1967. **Machine driving pressure-treated wood posts: A way to reduce guardrail costs.** Wood Preserv. News 45(8):13-15.

682. Gatchell, Charles J.
1967. **A way to reduce highway guardrail costs: Machine-driving of wooden posts.** USDA For. Serv. Res. Pap. NE-81. 19 p.

683. Gatchell, Charles J.
1968. **Machine-driving of wooden posts.** Highway Res. Recreation 222:89-98.

684. Gatchell, Charles J.
1971. **Black cherry.** USDA For. Serv. Am. Woods Ser. FS-229. 8 p.

685. Gatchell, Charles J., and Edwin L. Lucas.
1971. **Machine driving of wooden and steel highway guardrail posts under adverse conditions.** USDA Serv. Res. Pap. NE-212. 19 p.

686. Gatchell, Charles J., and Jarvis D. Michie.
1974. **Pendulum impact tests of wooden and steel highway guardrail posts.** USDA For. Serv. Res. Pap. NE-311. 20 p.

687. Gee, G. W., and C. A. Federer.
1972. **Stomatal resistance during senescense of hardwood leaves.** Water Resour. Res. 8:1456-1460.

688. Gerhold, H. D., A. J. Long, and M. E. Demeritt, Jr.
1975. **Genetic information needed for metropolitan trees.** J. For. 73:150-153.

689. Gerhold, H. D., E. H. Palpant, W. M. Chang, and M. E. Demeritt, Jr.
1972. **Tubing fumigation method for selection of pines resistant to air pollutants.** Mitt. Forstl. Bundes-Versuchsanst. Wien 97:511-520.

690. Gerhold, H. D., E. J. Schreiner, R. E. McDermott, and J. A. Winieski.
1966. **Breeding pest-resistant trees.** Pergamon Press, Oxford, England. 505 p.

691. Gerhold, Henry D., and Kim C. Steiner.
1976. **Selection practices of municipal arborists.** *In* Better trees for metropolitan landscapes symp. proc. USDA For. Serv. Gen. Tech. Rep. NE-22. p. 159-166.

692. Gibbs, Carter B.
1968. **Results of tubing research by the U.S. Forest Service.** Proc. 7th Conf. Maple Prod. p. 6-7.

693. Gibbs, Carter B.
1969. **The effect of xylem age on volume yield and sugar content of sugar maple sap.** USDA For. Serv. Res. Pap. NE-141. 11 p.

694. Gibbs, Carter B.
1969. **Highlights of Forest Service tubing research.** Natl. Maple Syrup Dig. 8(3):31-32.

695. Gibbs, Carter B.
1969. **Improving your sugar bush? Use fall sap sugar percentages.** Natl. Maple Syrup Dig. 8(1):18.

696. Gibbs, Carter B.
1973. **Northeastern spruce-fir.** *In* Silvicultural systems for the major forest types of the United States. U.S. Dep. Agric., Agric. Handb. 445. p. 71-72.

697. Gibbs, Carter B., and B. M. Blum.
1975. **Silviculture and the spruce budworm in Maine.** Maine For. Rev. 8:13-15.

698. Gibbs, Carter B., and James B. Carlaw.
1973. **The New England spruce-fir seed orchard program.** *In* Joint proc. of the 10th Lake States forest tree improvement conference and the 7th Central States forest tree improvement conference 1971. USDA For. Serv. Gen. Tech. Rep. NC-3. p. 53-56.

699. Gibbs, Carter B., and H. Clay Smith.
1970. **Sugarbush management research.** Natl. Maple Syrup Dig. 9(3):8-10.

700. Gibbs, Carter B., and H. Clay Smith.
1973. **Cambial dieback and taphole closure in sugar maple after tapping.** USDA For. Serv. Res. Note NE-155. 4 p.

701. Gibbs, Carter B., and Albert G. Snow.
1969. **Use for sap production.** *In* Proceedings sugar maple conference, 1968. Mich. Tech. Univ., Houghton. p. 88-93.

702. Gibson, Harry G.
1966. **New developments in transmissions, engines, and brakes for logging machines.** *In* Forest engineering symp. proc. W. Va. Univ. Tech. Bull. 82. p. 5-14.

703. Gibson, Harry G., and Cleveland J. Biller.
1971. **Side-slope stability of logging tractors and forwarders.** Am. Soc. Agric. Eng. Pap. 71-611. 19 p.

704. Gibson, Harry G., and Cleveland J. Biller.
1974. **Side-slope stability of logging tractors and forwarders.** Trans. Am. Soc. Agric. Eng. 17:245-250, illus.

705. Gibson, Harry G., and Cleveland J. Biller.
1975. **A second look at cable logging in the Appalachians.** J. For. 73:649-653.

706. Gibson, H. G., K. C. Elliott, and S. P. E. Persson.
1971. **Side-slope stability of articulated-frame logging tractors.** J. Terramechanics 8:65-79.

707. Gibson, Harry G., Donald L. Gochenour, Jr., Robert L. Hartman, and Homer W. Parker.
1967. **Wheeled skidder performance in steep terrain.** USDA For. Serv. Northeast. For. Exp. Stn. 26 p.

708. Gibson, Harry G., and Robert L. Hartman.
1966. **Selecting a wheel skidder for Appalachian logging.** South. Lumberman 213(2656):195-198.

709. Gibson, Harry G., Robert L. Hartman, Donald L. Gochenour, Jr., and Homer W. Parker.
1969. **Wheeled skidder performance on sloping terrain.** Agric. Eng. 50(3):152-154.

710. Gibson, H. G., and R. A. Phillips.
1973. **Cable systems: How do you select one for Appalachian logging?** *In* Cable logging symp. proc. Va. Polytech. Inst. and State Univ. Div. For. and Wildl. Sci. 27 p.

711. Gibson, Harry G., and Ross Phillips.
1974. **Austrian URUS skyline tested in Virginia and West Virginia mountains.** Am. Pulpwood Assoc. Tech. Release 74-R-8. 8 p.

712. Gibson, L. P.
1968. **Distribution of *Curculio* species in the New World.** (Abstr.) Entomol. Soc. Am. Bull. 14:211.

713. Gibson, Lester P.
1967. **Stridulatory mechanisms and sound production in *Conotrachelus* (Coleoptera: Curculionidae).** Ann. Entomol. Soc. Am. 60:43-54.

714. Gibson, Lester P.
1968. **The 1958 pine tip moth collapse in Ohio.** Ann. Entomol. Soc. Am. 61:786-787.

715. Gibson, Lester P.
1969. **Monograph of the genus *Curculio* in the New World (Coleoptera: Curculionidae). Part I. United States and Canada.** Entomol. Soc. Am. Misc. Publ. 6:241-285.

716. Gibson, Lester P.
1969. **A review of the insects affecting oak acorns and the types of damage incurred.** (Abstr.) Proc. North Cent. Branch Entomol. Soc. Am. 24:39.

717. Gibson, Lester P.
1971. **Insects of bur oak acorns.** Ann. Entomol. Soc. Am. 64:232-234.

718. Gibson, Lester P.
1972. **Insects that damage white oak acorns.** USDA For. Serv. Res. Pap. NE-220. 7 p.

719. Gibson, Lester P.
1972. **Revision of the genus *Urosigalphus* of the United States and Canada (Hymenoptera: Braconidae).** Entomol. Soc. Am. Misc. Publ. 8:85-133.

720. Gibson, Lester P.
1972. ***Urosigalphus* of Mexico and Central America (Hymenoptera: Braconidae).** Entomol. Soc. Am. Misc. Publ. 8:137-157.

721. Gibson, Lester P.
1973. **An annotated list of the Cicadellidae and Fulgoridae of elm.** USDA For. Serv. Res. Pap. NE-278. 5 p.

722. Gibson, Lester P.
1974. **South American *Urosigalphus* (Hymenoptera: Braconidae).** Entomol. Soc. Am. Misc. Publ. 9:203-226.

723. Gill, John D., Richard M. DeGraaf, and Jack Ward Thomas.
1974. **Forest habitat management for nongame birds in central Appalachia.** USDA For. Serv. Res. Note NE-192. 6 p.

724. Gill, John D., and William M. Healy.
1974. **A handbook on shrubs and vines.** *In* Shrubs and vines for northeastern wildlife. USDA For. Serv. Gen. Tech. Rep. NE-9. p. 1.

725. Gill, John D., and William M. Healy.
1974. **Shrubs and vines for northeastern wildlife.** USDA For. Serv. Gen. Tech. Rep. NE-9. 180 p.

726. Gill, John D., and Franz L. Pogge.
1974. ***Aronia* Med.: Chokeberry.** *In* Seeds of woody plants in the United States. U.S. Dep. Agric., Agric. Handb. 450. p. 232-234.

727. Gill, John D., and Franz L. Pogge.
1974. ***Chionanthus virginicus* L.: Fringetree.** *In* Seeds of woody plants in the United States. U.S. Dep. Agric., Agric. Handb. 450. p. 323-325.

728. Gill, John D., and Franz L. Pogge.
1974. *Cytisus scoparius* (L.) Lk.: **Scotch broom.** *In* Seeds of woody plants in the United States. U.S. Dep. Agric., Agric. Handb. 450. p. 370-371.

729. Gill, John D., and Franz L. Pogge.
1974. *Parthenocissus* **Planch.: Creeper.** *In* Seeds of woody plants in the United States. U.S. Dep. Agric., Agric. Handb. 450. p. 568-571.

730. Gill, John D., and Franz L. Pogge.
1974. *Physocarpus* **Maxim.: Ninebark.** *In* Seeds of woody plants in the United States. U.S. Dep. Agric., Agric. Handb. 450. p. 584-586.

731. Gill, John D., and Franz L. Pogge.
1974. *Pyrus* **L.: Pear.** *In* Seeds of woody plants in the United States. U.S. Dep. Agric., Agric. Handb. 450. p. 689-691.

732. Gill, John D., and Franz L. Pogge.
1974. *Rosa* **L.: Rose.** *In* Seeds of woody plants in the United States. U.S. Dep. Agric., Agric. Handb. 450. p. 732-737.

733. Gill, John D., and Franz L. Pogge.
1974. *Viburnum* **L.: Viburnum.** *In* Seeds of woody plants in the United States. U.S. Dep. Agric., Agric. Handb. 450. p. 844-850.

734. Gill, John D., Robert E. Radtke, and Jack Ward Thomas.
1976. **Forest wildlife habitat management: Ecological and management systems.** *In* The scientific base for silviculture and management decisions in the National Forest System: Selected papers. U.S. Dep. Agric., Washington, D.C. p. 52-58.

735. Gill, John D., Jack W. Thomas, William M. Healy, James C. Pack, and H. Reed Sanderson.
1975. **Comparison of seven forest types for game in West Virginia.** J. Wildl. Manage. 39:762-768.

736. Gill, John D., and David P. Worley.
1974. **Inventory for managing timber and wildlife habitat.** *In* University of Missouri timber-wildlife management symp. proc. Mo. Acad. Sci. Occas. Pap. 3. p. 26-32.

737. Gillespie, William H.
1971. **The oak wilt situation.** *In* Oak symp. proc. USDA For. Serv. Northeast. For. Exp. Stn. p. 124-128.

738. Gingrich, Samuel F.
1967. **Measuring and evaluating stocking and stand density in upland hardwood forests in the Central States.** For. Sci. 13:38-53.

739. Gingrich, Samuel F.
1969. **The effects of density, thinning, and species composition on the growth and yield of the oak and yellow-poplar types.** Soc. Am. For. Annu. Meet. (1968) Abstr. Pap. p. 23-24.

740. Gingrich, Samuel F.
1970. **Effects of density, thinning, and species composition on the growth and yield of eastern hardwoods.** *In* The silviculture of oaks and associated species. USDA For. Serv. Res. Pap. NE-144. p. 26-35.

741. Gingrich, Samuel F.
1971. **Management of young and intermediate stands of upland hardwoods.** USDA For. Serv. Res. Pap. NE-195. 26 p.

742. Gingrich, Samuel F.
1971. **Management of young and intermediate stands of upland hardwoods.** South. Appalachian Hardwoods Symp. Proc. 1970. Asheville, N.C. p. 70-97.

743. Gingrich, Samuel F.
1971. **Stocking, growth, and yield of oak stands.** *In* Oak symp. proc. USDA For. Serv. Northeast. For. Exp. Stn. p. 65-73.

744. Gladstone, William T., and Richard L. Gray.
1973. **Effects of forest fertilization on wood quality.** *In* Forest fertilization symp. proc. USDA For. Serv. Gen. Tech. Rep. NE-3. p. 167-173.

745. Glover, Ralph P., Jr., and Bruce G. Hansen.
1972. **The secondary forest industry of West Virginia—1972.** W. Va. Dep. Nat. Resour. 85 p.

746. Gochenour, Donald L., Jr.
1969. **Analysis of computer results of loading tests.** W. Va. Univ. Eng. Exp. Stn. Rep. 9. 40 p.

747. Gochenour, Donald L., Jr., and R. L. Hartman.
1968. **Factors affecting logging operations in hardwood forests.** North. Logger 17(3):20,22,38.

748. Gochenour, Donald L., Jr., and R. L. Hartman.
1968. **How wheeled skidders work on 40 percent hardwood slopes.** Can. For. Ind. 88:26-29.

749. Gochenour, Donald L., Jr., and Leonard R. Johnson.
1973. **Reliable results from stochastic simulation models.** USDA For. Serv. Res. Pap. NE-277. 5 p.

750. Godman, Richard M., and David A. Marquis.
1969. **Thinning and pruning in young birch stands.** *In* Birch symp. proc. USDA For. Serv. Northeast. For. Exp. Stn. p. 119-127.

751. Godwin, P. A., and T. M. ODell.
1967. **Experimental hybridization of** *Pissodes strobi* **and** *P. approximatus* **(Coleoptera: Curculionidae).** Ann. Entomol. Soc. Am. 60:55-58.

752. Godwin, P. A., and W. A. Reeks.
1967. **White-pine weevil** *Pissodes strobi* **(Peck).** *In* Important forest insects and diseases of mutual concern to Canada, the United States and Mexico. Can. Dep. For. Rural Dev. Publ. 1180. p. 148-151.

753. Goho, Curtis D.
1976. **A study of logging residue at woods landings in Appalachia.** USDA For. Serv. Res. Note NE-219. 4 p.

754. Goho, Curtis D., and A. Jeff Martin.
1973. **Sawlog sizes: A comparison in two Appalachian areas.** USDA For. Serv. Res. Note NE-160. 5 p.

755. Goho, Curtis D., and Paul S. Wysor.
1970. **Characteristics of factory-grade hardwood logs delivered to Appalachian sawmills.** USDA For. Serv. Res. Pap. NE-166. 17 p.

756. Goodhue, Sargent.
1969. **Birch management on New Hampshire state lands.** *In* Birch symp. proc. USDA For. Serv. Northeast. For. Exp. Stn. p. 169-171.

757. Gordon, Barry, and Thomas G. Lambrix.
1973. **The battle of Lynn Woods.** Nat. Hist. 82:76-81.

758. Gore, William E., Glenn T. Pearce, and Robert M. Silverstein.
1975. **Relative stereochemistry of multistriatin (2,4-dimethyl-5-ethyl-6, 8-dioxabicyclo [3.2.1] octane).** J. Organ. Chem. 40:1705-1708.

759. Gorska-Brylass, A., E. Galoch, and Z. Porazinski.
1976. **The dynamics of endogenous growth regulators during the development of male cones of** *Larix europea* L. Acta Univ. Nicolai Copernici Biol. 37:33-38.

760. Gouin, Francis R.
1976. **Winter injury to container-grown plants.** *In* Better trees for metropolitan landscapes symp. proc. USDA For. Serv. Gen. Tech. Rep. NE-22. p. 179-184.

761. Gove, J. P., and M. C. Hoyle.
1974. **Peroxidase isoenzymes of yellow birch and horseradish.** Am. Soc. Plant Physiol. Annu. Meet. Abstr. 230. p. 41.

762. Gove, James P., and Merrill C. Hoyle.
1975. **The isozymic similarity of IAA oxidase to peroxidase in birch and horseradish.** Plant Physiol. 56:684-687.

763. Graber, R. E.
1974. **Ground application methods in northeastern United States.** *In* Direct seeding symp. Can. For. Serv., Ontario. p. 113-117.

764. Graber, Raymond E.
1967. **Post-site treatment of competing vegetation following the establishment of direct-seeded conifers.** USDA For. Serv. Northeast. Area, State and Priv. For. Direct Seeding Workshop Summ. Univ. Mass., Amherst. p. 12.

765. Graber, Raymond E.
1967. **Site preparation for direct seeding conifers.** USDA For. Serv. Northeast. Area, State and Priv. For. Direct Seeding Workshop Summ. Univ. Mass., Amherst. p. 8-9.

766. Graber, Raymond E.
1968. **Planting site, shade, and local seed source: Their effects on the emergence and survival of eastern white pine seedlings.** USDA For. Serv. Res. Pap. NE-94. 12 p.

767. Graber, Raymond E.
1969. **Seed losses to small mammals after fall sowing of pine seed.** USDA For. Serv. Res. Pap. NE-135. 16 p.

768. Graber, Raymond E.
1970. **Natural seed fall in white pine (*pinus strobus* L.) stands of varying density.** USDA For. Serv. Res. Note NE-119. 6 p.

769. Graber, Raymond E.
1970. **A new way to direct-seed white pine.** N. H. For. Notes 101:32-33.

770. Graber, Raymond E.
1971. **Frost heaving as a cause of eastern pine seedling mortality.** Tree Plant. Notes 22(4):24-28.

771. Graber, R. E., W. B. Leak, and D. F. Thompson.
1973. **Maximum ages of some trees and shrubs on Mount Washington.** N.H. For. Notes 115:23-24.

772. Graber, R. E., and D. F. Thompson.
1967. **Mechanized direct seeding: A furrow seeder for rough stony land.** South. Lumberman 215(2680): 122-123.

773. Graber, Raymond E., and Donald F. Thompson.
1969. **A furrow-seeder for the Northeast.** USDA For. Serv. Res. Pap. NE-150. 14 p.

774. Gregory, G. F.
1968. ***Ceratocystis fagacearum* distribution within bur and red oak seedlings.** (Abstr.) Phytopathology 58:399.

775. Gregory, G. F.
1969. **Production and partial purification of a toxin produced *in vitro* by *Ceratocystis fagacearum*.** (Abstr.) Phytopathology 59:399.

776. Gregory, G. F.
1971. **Transpiration of bur oaks during oak wilt pathogenesis.** (Abstr.) Phytopathology 61:893.

777. Gregory, Garold F.
1966. **An apparatus for obtaining fluid from xylem vessels.** Phytopathology 56:463.

778. Gregory, Garold F.
1969. **A technique for inoculating plants with vascular pathogens.** Phytopathology 59:1014.

779. Gregory, Garold F.
1971. **Correlation of isolability of the oak wilt pathogen with leaf wilt and vascular water flow resistance.** Phytopathology 61:1003-1005.

780. Gregory, Garold F., and Keith F. Jensen.
1971. **A modified Lowry protein test for dilute protein solutions.** USDA For. Serv. Res. Note NE-136. 3 p.

781. Gregory, Garold F., and Thomas W. Jones.
1974. **Protection of sand-grown red oak seedlings from oak wilt disease by drenching with benomyl.** Plant Dis. Rep. 58:65-67.

782. Gregory, Garold F., and Thomas W. Jones.
1975. **An improved apparatus for pressure-injecting fluid into trees.** USDA For. Serv. Res. Note NE-214. 6 p.

783. Gregory, Garold F., Thomas W. Jones, and Percy McWain.
1971. **Injection of benomyl into elm, oak, and maple.** USDA For. Serv. Res. Pap. NE-232. 7 p.

784. Gregory, Garold F., Thomas W. Jones, and Percy McWain.
1973. **Pressure injection of methyl 2-benzimidazole carbamate hydrochloride solution as a control for Dutch elm disease.** USDA For. Serv. Res. Note NE-176. 9 p.

785. Gregory, G. F., and P. McWain.
1969. **General characteristics of a toxin produced by *Ceratosystis fagacearum*.** (Abstr.) Phytopathology 59:399.

786. Gregory, G. F., P. McWain, and T. W. Jones.
1972. **Effectiveness of benomyl as a protectant and therapeutant for oak wilt disease in red oak seedlings.** (Abstr.) Phytopathology 62:761.

787. Gregory, Garold F., and Carl E. Seliskar.
1970. **A virus-like disorder of overcup oak.** Plant Dis. Rep. 54:844-846.

788. Gregory, Robert A.
1966. **The effect of leaf litter upon establishment of white spruce beneath paper birch.** For. Chron. 42:251-255.

789. Gregory, R. A., and J. A. Romberger.
1972. **The shoot apical ontogeny of the *Picea abies* seedling. I. Anatomy, spical dome diameter, and plastochron duration.** Am. J. Bot. 59:587-597.

790. Gregory, R. A., and J. A. Romberger.
1972. **The shoot apical ontogeny of the *Picea abies* seedling. II. Growth rates.** Am. J. Bot. 59:598-606.

791. Gregory, R. A., and J. A. Romberger.
1975. **Cambial activity land height of uniseriate vascular rays in conifers.** Bot. Gaz. 136:246-253.

792. Grisez, T. J.
1967. **Pruning open-grown black cherry.** USDA For. Serv. Res. Note NE-57. 7 p.

793. Grisez, Ted J.
1968. **Growth and development of older plantations in northwestern Pennsylvania.** USDA For. Serv. Res. Pap. NE-104. 40 p.

794. Grisez, Ted. J.
1974. ***Prunus* L.: Cherry, peach, and plum.** *In* Seeds of woody plants in the United States. U. S. Dep. Agric., Agric. Handb. 450. p. 658-673.

795. Grisez, Ted J.
1975. **Flowering and seed production in seven hardwood species.** USDA For. Serv. Res. Pap. NE-315. 8 p.

796. Grisez, Ted J.
1976. **Black cherry seeds stored 8 years.** Tree Plant. Notes 27. p. 20-24.

797. Grisez, Ted J., and Joseph J. Mendel.
1972. **The rate of value increase for black cherry, red maple, and white ash.** USDA For. Serv. Res. Pap. NE-231. 26 p.

798. Grisez, Ted J., and Maurice R. Peace.
1973. **Requirements for advance reproduction in Allegheny hardwoods: An interim guide.** USDA For. Serv. Res. Note NE-180. 5 p.

799. Hacskaylo, E.
1972. **Mycorrhizae: The ultimate in reciprocal parasitism.** BioScience 22:577-583.

800. Hacskaylo, E.
1973. **Dependence of mycorrhizal fungi on hosts.** Torrey Bot. Club Bull. 100:217-223.

801. Hacskaylo, Edward.
1973. **Carbohydrate physiology of ectomycorrhizae.** *In* Ectomycorrhizae, Chapter 6. Academic Press, New York. p. 207-230.

802. Hacskaylo, E., and G. Bruchet.
1972. **Hebelomas as mycorrhizal fungi.** Torrey Bot. Club Bull. 99:17-20.

803. Hacskaylo, E., and C. M. Tompkins.
1973. **World literature on mycorrhizae.** Reed Herb. Contrib. 22. 142 p.

804. Hadley, Lawrence C.
1971. **Perspectives on law enforcement in recreation areas.** *In* Recreation symp. proc. USDA For. Serv. Northeast. For. Exp. Stn. p. 156-160.

805. Hafley, W. L., and Hansen, K. W.
1973. **Optimum sequence of cutting bills.** For. Prod. J. 23(8):26-29.

806. Hagenstein, Perry R.
1966. **Projecting regional timber-products production.** *In* Forest resource decisions in a changing power structure. Proc. Soc. Am. For. 1965. p. 92-94.

807. Hajny, G. J., R. N. Jorgensen, and J. J. Ferrigan.
1967. **Outside storage of hardwood chips in the Northeast. I. Physical and chemical effects.** TAPPI 50:92-96.

808. Hajny, George J., Richard N. Jorgensen, and James J. Ferrigan.
1966. **Outside storage of hardwood chips in the Northeast. I. Physical and chemical effects.** U.S. For. Prod. Lab. 30 p.

809. Hamilton, John F., Jr.
1971. **An opinion about the future of forest recreation research.** *In* Recreation symp. proc. USDA For. Serv. Northeast. For. Exp. Stn. p. 194-196.

810. Hamilton, J. R., and G. W. Wendel.
1967. **Specific gravity and fiber length of some hybrid poplars growing in West Virginia.** W. Va. Univ. Agric. Exp. Stn. Bull. 556T. 6 p.

811. Hamilton, Tom S., Jr.
1974. **Eastern hophornbeam.** *In* Shrubs and vines for northeastern wildlife. USDA For. Serv. Gen. Tech. Rep. NE-9. p. 83-85.

812. Hamilton, Tom S., Jr.
1974. **Sassafras.** *In* Shrubs and vines for northeastern wildlife. USDA For. Serv. Gen. Tech. Rep. NE-9. p. 122-125.

813. Hanks, Leland F.
1969. **Which indicator is best: A preview of hardwood tree grades.** Abstr. Pap. Annu. Meet. Soc. Am. For. 1968. p. 13.

814. Hanks, Leland F.
1971. **Interim hardwood tree grades for factory lumber.** USDA For. Serv. Res. Pap. NE-199. 29 p.

815. Hanks, Leland F.
1973. **Green lumber grade yields for sub-factory class hardwood logs.** USDA For. Serv. Res. Pap. NE-256. 8 p.

816. Hanks, Leland F.
1975. **New tools for grading hardwood trees.** South. Lumberman 231(2872):49-50.

817. Hanks, Leland F.
1976. **Field trials of the Forest Service hardwood tree grades.** For. Prod. J. 26(6):47-49.

818. Hanks, Leland F.
1976. **Hardwood tree grades for factory lumber.** USDA For. Serv. Res. Pap. NE-333. 81 p.

819. Hanks, Leland F.
1976. **How to predict lumber-grade yields for graded trees.** USDA For. Serv. Gen. Tech. Rep. NE-20. 9 p.

820. Hanks, Leland F., and Margaret K. Peirsol.
1975. **Value loss of hardwood lumber during air-drying.** USDA For. Serv. Res. Pap. NE-309. 10 p.

821. Hanks, Leland F., and Carl W. Swanson.
1967. **Lumber grade yields from paper birch and balsam poplar logs in the Susitna River Valley, Alaska.** USDA For. Serv. Res. Pap. PNW-51. 30 p.

822. Hanks, Sidney.
1969. **Birch nursery practice.** *In* Birch symp. proc. USDA For. Serv. Northeast. For. Exp. Stn. p. 83-85.

823. Hanover, J. W., and R. C. Wilkinson.
1970. **Chemical evidence for introgressive hybridization in Picea.** Silvae Genet. 19(1):17-22.

824. Hanover, S. J., W. L. Hafley, A. G. Mullin, and R. K. Perrin.
1973. **Linear programming and sensitivity analysis for hardwood dimension production.** For. Prod. J. 23(11):47-50.

825. Hansen, Bruce G.
1968. **Christmas tree marketing: A bibliography.** Am. Christmas Tree J. 12(2):33-36.

826. Hansen, Bruce G.
1973. **Natural versus artificial: Where do we stand?** Cornell Sch. Christmas Tree Growers Proc. p. 85-96.

827. Hansen, Bruce G.
1974. **The Christmas tree industry: A preliminary report.** Am. Christmas Tree J. 18(3):5-8.

828. Hansen, Bruce G.
1976. **Ohio's Christmas tree industry.** Ohio Woodlands 14(4):12-14.

829. Hansen, Bruce G., and Thomas H. Pendleton.
1976. **The rise and fall of Christmas tree imports.** Am. Christmas Tree J. 20(2):9-10.

830. Hansen, Bruce G., and B. J. Warder.
1970. **The West Virginia sawmill industry—1967.** W. Va. Dept. Nat. Resour. 53 p.

831. Harper, D. O., and H. P. Simons.
1966. **Explosives, propellants, and exotic fuels for forestry operations.** *In* Forest engineering symp. proc. W. Va. Univ. Tech. Bull. 82. p. 95-99.

832. Hart, A. C.
1966. **Research programs of Northeastern Forest Experiment Station.** Tech. Pap. Am. Pulpwood Assoc. Jan. 1966. p. 23-25.

833. Hart, Arthur C., Herschel G. Abbott, and Edward R. Ladd.
1968. **Do small mammals and birds affect reproduction of spruce and fir?** USDA For. Serv. Res. Pap. NE-110. 8 p.

834. Hart, George.
1966. **Forest cutting to increase streamflow in the White Mountains.** N.H. For. Notes 89:6-9.

835. Hart, George E.
1967. **New stream-gaging instruments.** *In* International symp. on forest hydrology proc. Pergamon Press, Oxford, England, p. 787-790.

836. Hart, Irving A.
1975. **Current management practices on the Hartford Municipal Watershed.** *In* Municipal watershed management symp. proc. USDA For. Serv. Gen. Tech. Rep. NE-13. p. 111-114.

837. Hartley, Brent, A.
1975. **Current management practices on the Baltimore Municipal Watersheds.** *In* Municipal watershed management symp. proc. USDA For. Serv. Gen. Tech. Rep. NE-13. p. 84-97.

838. Hartman, Robert L.
1966. **Selecting and training logging machine operators.** *In* Forest engineering symp. proc. W. Va. Univ. Tech. Bull. 82. p. 91-94.

839. Hartman, Robert L., and Harry G. Gibson.
1970. **Techniques for the wheeled-skidder operator.** USDA For. Serv. Res. Pap. NE-170. 18 p.

840. Hartman, Robert L., and Harry G. Gibson.
1971. **Techniques for the wheeled-skidder operator.** South. Lumberman 222(2760):89-90,92,94,96-98.

841. Hartman, Robert L., and Ross A. Phillips.
1970. **Bunching with the wheeled skidder.** North. Logger 19(4):32-33.

842. Hastings, A. R., and P. A. Godwin.
1971. **White-pine weevil.** U.S. Dep. Agric. For. Serv. For. Pest Leafl. 21 (Rev.) 7 p.

843. Hay, C. J.
1970. **The life history of a red oak borer and its behavior in red, black, and scarlet oak.** Proc. North Cent. Branch Entomol. Soc. Am. 24:125-127.

844. Hay, C. J.
1976. **Arthropod stress.** *In* Air pollution and metropolitan woody vegetation. USDA For. Serv. Pinchot Inst. Environ. For. Stud. p.33-34.

845. Hay, C. John.
1968. **Frass of some wood-boring insects in living oak (Coleoptera: Cerambycidae; Lepidoptera: Cossidae and Aegeriidae).** Ann. Entomol. Soc. Am. 61:255-258.

846. Hay, C. John.
1968. **The red oak borer, biological notes and a possible silvicultural control method.** (Abstr.) Proc. North. Cent. Branch Entomol. Soc. Am. 23:46-47.

847. Hay, C. John.
1972. **Red oak borer (Coleoptera: Cerambycidae) emergence from oak in Ohio.** Ann. Entomol. Soc. Am. 65:1243-1244.

848. Hay, C. John.
1972. **Woodpecker predation on red oak borer in black, scarlet, and northern red oak.** Ann. Entomol. Soc. Am. 65:1421-1423.

849. Hay, C. John.
1974. **Survival and mortality of red oak borer larvae on black, scarlet, and northern red oak in eastern Kentucky.** Ann. Entomol. Soc. Am. 67:981-986.

850. Hay, C. John.
1974. **Timber beetle defect in black oak in western North Carolina.** South. Lumberman 228(2826):9-10.

851. Hay, Cyrus J.
1969. **Relating the life history of a red oak borer to its behavior in red, black, and scarlet oak.** (Abstr.) Proc. North Cent. Branch Entomol. Soc. Am. 24:39.

852. Hay, C. John, and David E. Donley.
1966. **Insect pests.** *In* Black walnut culture. USDA For. Serv. North. Cent. For. Exp. Stn. Walnut Workshop Pap. p. 83-87.

853. Hay, C. John, and David E. Donley.
1966. **Insect pests.** North. Nut Growers Assoc. Nutshell 14(1):14-17.

854. Hay, C. J., and R. C. Morris.
1970. **Carpenterworm.** U.S. Dep. Agric. For. Serv. For. Pest Leafl. 64 (Rev.) 8 p.

855. Heagy, James F.
1975. **Current management practices on private municipal watersheds.** *In* Municipal watershed management symp. proc. USDA For. Serv. Gen. Tech. Rep. NE-13. p. 124-128.

856. Healy, W. M.
1968. **Forage preference determination through use of tame deer.** Trans. Northeast Sect. Wildl. Soc. Northeast Fish Wildl. Conf. 25. p. 35-39.

857. Healy, William M.
1971. **Forage preferences of tame deer in a northwest Pennsylvania clearcutting.** J. Wildl. Manage. 35:717-723.

858. Healy, William M.
1974. **Wild Turkey traits.** Turkey Call 2(1):17-24.

859. Healy, William M., and John D. Gill.
1974. **Alders.** *In* Shrubs and vines for northeastern wildlife. USDA For. Serv. Gen. Tech. Rep. NE-9. p. 6-9.

860. Healy, W. M., and E. J. Goetz.
1975. **Imprinting and video-recording wild turkeys: New techniques.** Wildl. Soc. Northeast. Sect. Trans. 31:172-182.

861. Healy, William M., Richard O. Kimmel, and Ellen J. Goetz.
1975. **Behavior of human-imprinted and hen reared wild turkey poults.** *In* 3rd wild turkey symp. proc. Texas Parks and Wildl. Dep., Austin. p. 97-107.

862. Healy, William M., and Sadie L. Robinette.
1974. **Huckleberries.** *In* Shrubs and vines for northeastern wildlife. USDA For. Serv. Gen. Tech. Rep. NE-9. p. 89-92.

863. Healy, W. M., and J. W. Thomas.
1973. **Effects of dusting on plumage of Japanese quail.** Wilson Bull. 85:442-448.

864. Heck, Walter W., and Leon S. Dochinger.
1969. **Pollution dwarf white pines.** Agric. Res. 18(2):4.

865. Heinselman, Miron L.
1971. **Preserving nature in forested wilderness areas and national parks.** *In* Recreation symp. proc. USDA For. Serv. Northeast. For. Exp. Stn. p. 57-67.

866. Heisler, Gordon M.
1974. **Trees and human comfort in urban areas.** J. For. 72:466-469.

867. Heisler, Gordon M.
1975. **How trees modify metropolitan climate and noise.** *In* Forestry issues in urban America. Proc. Soc. Am. For. 1974. p. 103-112.

868. Heisler, Gordon M., and Lee P. Herrington.
1976. **Selection of trees for modifying metropolitan climates.** *In* Better trees for metropolitan landscapes symp. proc. USDA For. Serv. Gen. Tech. Rep. NE-22. p. 31-37.

869. Hejnowicz, Z.
1973. **Morphogenetic waves in the cambia of trees.** Plant Sci. Lett. 1:359-366.

870. Hejnowicz, Z.
1975. **A model for a morphogenetic map and clock.** J. Theor. Biol. 54:345-362.

871. Hejnowicz, Zygmunt.
1974. **Pulsations of domain length as support for the hypothesis of morphogenetic waves in the cambium.** Acta Soc. Bot. Pol. 43:261-271.

872. Hejnowicz, Z., and J. A. Romberger.
1973. **Migrating cambial domains and the origin of wavy grain in xylem of broad leaved trees.** Am. J. Bot. 60:209-222.

873. Hejnowicz, Z., and B. Zagórska-Marek.
1974. **Mechanism of changes in grain inclination in wood produced by storeyed cambium.** Acta Soc. Bot. Pol. 43:381-398.

874. Heller, R. C., J. H. Lowe, Jr., R. C. Aldrich, and F. P. Weber.
1967. **A test with large scale aerial**

photographs to sample balsam woolly aphid damage in the Northeast. J. For. 65:10-18.

875. Hendee, John C.
1971. **Membership in conservation groups and outdoor clubs.** *In* Recreation symp. proc. USDA For. Serv. Northeast. For. Exp. Stn. p. 123-127.

876. Hepting, George H., and Alex L. Shigo.
1972. **Difference in decay rate following fire between oaks in North Carolina and Maine.** Plant Dis. Rep. 56:406-407.

877. Herrick, Owen W.
1967. **A look at Kentucky's lumber industry.** USDA For. Serv. Res. Pap. NE-63. 11 p.

878. Herrick, Owen W.
1973. **Delimiting regional sub-areas for studies of timber-resource-based activity in the Northeast.** For. Sci. 19:180-189.

879. Herrick, Owen W.
1975. **A profile of logging in the Northeast. Part I. Crew size and equipment investment.** North. Logger 24(4):14-15.

880. Herrick, Owen W.
1975. **A profile of logging in the Northeast. Part II.** North. Logger 24(5):20-21.

881. Herrick, Owen W.
1976. **Key indicators of successful logging jobs in the Northeast.** USDA For. Serv. Res. Pap. NE-352. 5 p.

882. Herrick, Owen W.
1976. **Structure and change in northern U.S. forest industry: A shift-share analysis.** For. Prod. J. 26(8):29-35.

883. Herrick, Owen W., and W. W. Christensen.
1967. **A cost analysis of chip manufacture at hardwood sawmills.** USDA For. Serv. Res. Pap. NE-69. 14 p.

884. Herrick, Owen W., and J. Edwin Morse.
1968. **Investment analyses of stand improvement and reforestation opportunities in Appalachian forests.** USDA For. Serv. Res. Pap. NE-111. 43 p.

885. Herrington, Lee P.
1974. **Trees and acoustics in urban areas.** J. For. 72:462-465.

886. Herrington, L. P., and G. M. Heisler.
1973. **Microclimate modification due to power transmission rights of way.** *In* Power lines and the environment. N. Y. Bot. Gard. Cary Arbor. p. 36-57.

887. Herrington, L. P., R. E. Leonard, and G. E. Bertolin.
1972. **Microclimate of a suburban park.** (Abstr.) Am. Meteorol. Soc. Bull. 53:708.

888. Herrington, L. P., R. E. Leonard, J. E. Hamilton, and G. M. Heisler.
1972. **The response of moving radiometers.** Boundary-Layer Meteorol. 2:395-405.

889. Hetherington, John W.
1971. **The snowmobile.** *In* Recreation symp. proc. USDA For. Serv. Northeast. For. Exp. Stn. p. 143-148.

890. Hewlett, John D., Howard W. Lull, and Kenneth G. Reinhart.
1969. **In defense of experimental watersheds.** Water Resour. Res. 5:306-316.

891. Heybroek, Hans M.
1976. **Chapters on the genetic improvement of elms.** *In* Better trees for metropolitan landscapes symp. proc. USDA For. Serv. Gen. Tech. Rep. NE-22. p. 203-213.

892. Himelick, E. B.
1976. **Disease stresses of urban trees.** *In* Better trees for metropolitan landscapes symp. proc. USDA For. Serv. Gen. Tech. Rep. NE-22. p. 113-125.

893. Hock, Winant K., and Frederick H. Berry.
1975. **Sycamore anthracnose.** U.S. Dep. Agric., Agric. Handb. 470. p. 89-91.

894. Hock, W. K., and L. S. Dochinger.
1971. **Chemotherapeutic control of stem crown gall of Sherrill hybrid poplar trees.** (Abstr.) Phytopathology 61:129.

895. Hogan, William G., and Samuel M. Brock.
1971. **The effect of workmen's compensation on the logging and sawmilling industries in the Northeast.** W. Va. Univ. Off. Res. Dev. Res. Ser. 17. 37 p.

896. Holland, I. I., E. Kallio, and K. L. Quigley.
1966. **Prospects for hardwood pulp manufacture in Illinois.** Univ. Ill. Agric. Exp. Stn. Bull. 718. 83 p.

897. Holt, William R.
1968. **A further note on sample size for chi-square test: The r x c table.** J. Econ. Entomol. 61:853-854.

898. Holt, W. R., B. H. Kennedy, and J. W. Peacock.
1967. **Formulae for estimating sample size for chi-square test.** J. Econ. Entomol. 60:286-288.

899. Holweg, Arthur W.
1974. **Common winterberry.** *In* Shrubs and vines for northeastern wildlife. USDA For. Serv. Gen. Tech. Rep. NE-9. p. 150-153.

900. Hooper, Robert G., E. Frank Smith, Hewlette S. Crawford, Burd S. McGinnes, and Vernon J. Walker.
1975. **Nesting bird populations in a new town.** Wildl. Soc. Bull. 3(3):111-118.

901. Hopkins, Walter S.
1971. **Expanding and strengthening outdoor recreation research.** *In* Recreation symp. proc. USDA For. Serv. Northeast. For. Exp. Stn. p. 197-199.

902. Hopkins, W. S., and W. F. LaPage.
1970. **The future of American forest recreation areas.** 6th World For. Congr. Proc. vol. 3. p. 3610-3617.

903. Hornbeck, J. W.
1968. **Protecting water quality during and after clearcutting.** J. Soil & Water Conserv. 23:19-20.

904. Hornbeck, J. W.
1970. **The radiant energy budget of clearcut and forested sites in West Virginia.** For. Sci. 16:139-145.

905. Hornbeck, James.
1967. **Clearcutting and the erosion hazard.** North. Logger 16(4):14-15, 38-39,48.

906. Hornbeck, James W.
1973. **The problem of extreme events in paired-watershed studies.** USDA For. Serv. Res. Note NE-175. 4 p.

907. Hornbeck, James W.
1973. **Storm flow from hardwood-forested and cleared watersheds in New Hampshire.** Water Resour. Res. 9:346-354.

908. Hornbeck, James W.
1975. **Streamflow response to forest cutting and revegetation.** Water Resour. Bull. 11:1257-1260.

909. Hornbeck, James W., and C. Anthony Federer.
1973. **Forests and floods.** N. H. For. Notes 117:18-21.

910. Hornbeck, James W., and C. Anthony Federer.
1975. **Effects of management practices on water quality and quantity: Hubbard Brook Experimental Forest, New Hampshire.** *In* Municipal watershed management symp. proc. USDA For. Serv. Gen. Tech. Rep. NE-13. p. 58-65.

911. Hornbeck, James W., C. Anthony Federer, and Robert S. Pierce.
1974. **Managing New Hampshire forests for water.** N. H. Water Works Assoc. 35(4): 7-18.

912. Hornbeck, James W., and Gene E. Likens.
1974. **The ecosystem concept for determining the importance of chemical composition of snow.** *In* Advanced concepts and techniques in the study of snow and ice resources. National Academy of Sciences, Washington, D.C. p. 139-151.

913. Hornbeck, James W., and Gene E. Likens.
1974. **Importance of the chemical composition of the snowpack.** East. Snow Conf. Proc. 31:145-155.

914. Hornbeck, James W., Gene E. Likens, and John S. Eaton.
1976. **Seasonal patterns in acidity of precipitation and their implications for forest stream ecosystems.** *In* Proc. of the first international symp. on acid precipitation and the forest ecosystem. USDA For. Serv. Gen. Tech. Rep. NE-23. p. 597-609.

915. Hornbeck, J. W., G. E. Likens, R. S. Pierce, and F. H. Bormann.

1975. **Strip cutting as a means of protecting site and streamflow quality when clearcutting northern hardwoods.** *In* Forest soils and forest land management. Proc. 4th North Am. For. Soils Conf. p. 209-225.

916. Hornbeck, James W., and Robert S. Pierce.
1969. **Changes in snowmelt runoff after forest clearing on a New England watershed.** East. Snow Conf. Proc. 26:104-112.

917. Hornbeck, James W., and Robert S. Pierce.
1973. **Potential impact of forest fertilization on streamflow.** *In* Forest fertilization symp. proc. USDA For. Serv. Gen. Tech. Rep. NE-3. p. 79-87.

918. Hornbeck, J. W., R. S. Pierce, and C. A. Federer.
1970. **Streamflow changes after forest clearing in New England.** Water Resour. Res. 6:1124-1132.

919. Hornbeck, J. W., R. S. Pierce, G. E. Likens, and C. W. Martin.
1975. **Moderating the impact of contemporary forest cutting on hydrologic and nutrient cycles.** Int. Assoc. Hydrol. Sci. Symp. Publ. 117. p. 423-433.

920. Hornbeck, J. W., R. S. Pierce, and C. W. Martin.
1975. **Forest cutting in New Hampshire increases volume and ionic concentrations of streamflow.** *In* Forestry issues in urban America. Proc. Soc. Am. For. 1974. p. 195-199.

921. Hornbeck, James, and Gordon Stuart.
1976. **When ski trails are cut through forest land, what happens to streamflow?** Ski Area Manage. 15(4):34-36,47.

922. Hornbeck, James W., and Charles A. Troendle.
1969. **Effects of abandoned farmland on streamflow.** W. Va. Agric. For. 2(1):9-10.

923. Horowitz, Sylvia, and Mary Buchanan.
1967. **Publications of the Northeastern Forest Experiment Station 1950-1965.** USDA For. Serv. Res. Pap. NE-62. 134 p.

924. Hosier, Paul E.
1974. **Maples.** *In* Shrubs and vines for northeastern wildlife. USDA For. Serv. Gen. Tech. Rep. NE-9. p. 93-95.

925. Hosier, Paul E.
1974. **Striped maple.** *In* Shrubs and vines for northeastern wildlife. USDA For. Serv. Gen. Tech. Rep. NE-9. 96-97.

926. Hough, Ashbel F.
1967. **Twenty-five year results of a red pine provenance study.** For. Sci. 13:156-166.

927. Houston, D. R.
1969. **Basal canker of white pine.** For. Sci. 15:66-83.

928. Houston, D. R.
1970. **Comparison of infrared color and true-color aerial photography for studying beech bark disease.** Aerial Color Photogr. Plant Sci. Workshop Proc. Gainesville, Fla. p. 76-77.

929. Houston, D. R.
1971. **Chemical limitation of discoloration and decay associated with wounds in red maple and yellow birch.** (Abstr.) Phytopathology 61:889.

930. Houston, D. R.
1972. **Large-scale aerial color photograph: A tool for studying forest tree diseases.** Phytopathology 62:495.

931. Houston, David R.
1966. **Strumella canker of oaks.** U.S. Dep. Agric. For Serv. For. Pest Leafl. 101. 8 p.

932. Houston, David R.
1967. **The dieback and decline of northeastern hardwoods.** Trees Mag. 28(1):12-14.

933. Houston, David R.
1969. **The dieback and decline of northeastern hardwoods.** Pa. For. 59:18-20.

934. Houston, David R.
1971. **Discoloration and decay in red maple and yellow birch: Reduction through wound treatment.** For. Sci. 17:402-406.

935. Houston, David R.
1971. **Noninfectious diseases of oaks.** *In* Oak symp. proc. USDA For. Serv. Northeast. For. Exp. Stn. p. 118-123.

936. Houston, David R.
1972. **Review of "Diseases of forest trees and forest products, a text and reference for general foresters," by A. F. Verrall.** Phytopathol. News 6(8):4.

937. Houston, David R.
1972. **The use of large-scale aerial color photography for assessing forest tree disease. I. Basal canker of white pine: A case study.** USDA For. Serv. Res. Pap. NE-230. 7 p.

938. Houston, David R.
1973. **Diebacks and declines: Diseases initiated by stress, including defoliation.** Int. Shade Tree Conf. Proc. 49:73-76.

939. Houston, David R.
1974. **Basal canker disease of white pine: Ecological comparison between disease development in New York and Maine.** (Abstr.) Phytopathology 64: 582.

940. Houston, David R.
1974. **Diagnosing and preventing diebacks and declines of urban trees: Lessons from some forest counterparts.** Morton Arbor. Q. 10(4):55-59.

941. Houston, David R.
1974. **Diebacks and declines: diseases initiated by stress, including defoliation.** Arborist's News 49:73-76. [Reprinted from Int. Shade Tree Conf. Proc. 49:73-76. 1973.]

942. Houston, David R.
1975. **Aerial inventory of forest tree diseases.** *In* Symp. monitoring forest environment through successive sampling proc. p. 344-354.

943. Houston, David R.
1975. **Beech bark disease.** J. For. 73:660-663.

944. Houston, David R.
1975. **Occurrence of basal canker of white pine in Maine.** Plant Dis. Rep. 59:74-76.

945. Houston, David R.
1975. **Soil fumigation to control spread of *Fomes annosus:* Results of field trials.** USDA For. Serv. Res. Pap. NE-327. 4 p.

946. Houston, David R., and Harold G. Eno.
1969. **Use of soil fumigants to control spread of *Fomes annosus.*** USDA For. Serv. Res. Pap. NE-123. 23 p.

947. Howe, George E.
1969. **Early results of sugar maple provenance study.** 16th Northeast. For. Tree Improv. Conf. Proc. p. 27.

948. Howe, George E.
1969. **A vibrator for collecting pollen.** For. Sci. 15:144.

949. Hoy, Marjorie A.
1975. **Diapause in the mite, *Metaseiulus occidentalis:* Stages sensitive to photoperiodic induction.** J. Insect Physiol. 21:745-751.

950. Hoy, Marjorie A.
1975. **Effect of temperature and photoperiod on the induction of diapause in the mite, *Metaseiulus occidentalis*** J. Insect Physiol. 21:605-611.

951. Hoy, Marjorie A.
1975. **Forest and laboratory evaluations of hybridized *Apanteles melanoscelus* (Hym.: Branconidae), a parasitoid of *Porthetria dispar* (Lep.: Lymantriidae).** Entomophaga 20:261-268.

952. Hoy, Marjorie A.
1975. **Hybridization of strains of the gypsy moth parasitoid, *Apanteles melanoscelus* and its influence upon diapause.** Ann. Entomol. Soc. Am. 68:261-264.

953. Hoy, Marjorie A.
1975. **Improving the quality of laboratory-reared insects.** J. N.Y. Entomol. Soc. 83:276-277.

954. Hoy, Marjorie A.
1976. **Genetic improvement of insects: Fact or fantasy.** Environ. Entomol. 5:833-839.

955. Hoy, Marjorie A.
1976. **Parasite evaluation and management.** *In* Proc. of the eighth annual northeastern forest insect work conference. USDA For. Serv. Gen. Tech. Rep. NE-27. p. 18-19.

956. Hoy, Marjorie A., and Donald L. Flaherty.
1975. **Diapause induction and duration in vineyard-collected *Metaseiulus occidentalis*.** Environ. Entomol. 4:262-264.

957. Hoyle, M. C.
1968. **Growth and nutrient composition of yellow birch in split-medium cultures.** Agron. Abstr. p. 136.

958. Hoyle, M. C.
1969. **Response of yellow birch in acid subsoil to macronutrient additions.** Soil Sci. 108:354-358.

959. Hoyle, M. C.
1969. **Variation in content of microelements in yellow birch foliage due to season and soil drainage.** Soil Sci. Soc. Am. Proc. 33:458-459.

960. Hoyle, M. C.
1970. **Growth and nutrition of yellow birch as affected by the nutrient status of a podzol soil.** *In* Tree growth and forest soils. Proc. 3rd North Am. For. Soils Conf. p. 221-233.

961. Hoyle, M. C.
1971. **Effects of the chemical environment on yellow birch root development and top growth.** Plant and Soil 35:623-633.

962. Hoyle, M. C.
1972. **Indoleacetic acid oxidase: A dual catalytic enzyme?** Plant Physiol. 50:15-18.

963. Hoyle, M. C.
1972. **Manganese toxicity in yellow birch** ***(Betula alleghaniensis*** **Britton) seedlings.** Plant and Soil 37:229-232.

964. Hoyle, M. C.
1973. **Nature and properties of some forest soils in the White Mountains of New Hampshire.** USDA For. Serv. Res. Pap. NE-260. 18 p.

965. Hoyle, M. C.
1975. **High yield birch: Nurture and nourish.** North. Logger 24(1):20-21, 36-38.

966. Hoyle, Merrill C.
1966. **Diameter growth of yellow birch not closely related to density.** J. For. 64:628-629.

967. Hoyle, Merrill C.
1966. **Forest soils in the White Mountains: A look at the forest floor.** N.H. For. Notes 90:3-9.

968. Hoyle, Merrill C.
1970. **Characteristics of IAA oxidase activity in yellow birch** *(Betula alleghaniensis).* (Abstr.) 1st North Am. For. Biol. Workshop. Mich. State Univ., East Lansing.

969. Hoyle, Merrill C., and John C. Bjorkbom.
1969. **Birch nutrition.** *In* Birch symp. proc. USDA For. Serv. Northeast. For. Exp. Stn. p. 102-105.

970. Hoyle, M. C., E. R. Hager, and J. P. Gove.
1974. **Problems in total extraction of 1AA oxidase from birch leaves.** North Am. For. Biol. Workshop Proc. 3:361. Fort Collins, Colo.

971. Hubbard, Harry B., Jr., and Franklin B. Lewis.
1973. **A spray tower for the application of microbial aerial sprays.** USDA For. Serv. Res. Pap. NE-249. 8 p.

972. Hughes, Jay M., and Boyd W. Post.
1973. **Economic considerations in forest fertilization.** *In* Forest fertilization symp. proc. USDA For. Serv. Gen. Tech. Rep. NE-3. p. 45-54.

973. Hungund, Basalingappa L., and Chandravadan H. Pathak.
1971. **A survey of plants in Gujarat, India, for alkaloids, saponins, and tannins.** USDA For. Serv. Res. Pap. NE-201. 11 p.

974. Huntzinger, H. J.
1972. **Direct seeding black cherry: Some recommendations for the Allegheny Plateau.** Tree Plant. Notes 23(1):10-11.

975. Huntzinger, Harold J.
1967. **Seeding black cherry in regeneration cuttings.** USDA For. Serv. Res. Note NE-63. 8 p.

976. Huntzinger, Harold J.
1968. **Methods for handling black cherry seed.** USDA For. Serv. Res. Pap. NE-102. 22 p.

977. Huntzinger, Harold J.
1971. **Long-term storage of black cherry seed.** Tree Plant. Notes 22(4):3-4.

978. Hutnik, Russell J., and Grant Davis, eds.
1973. **Ecology and reclamation of devastated land.** Vol. I, Vol. II. Gordon & Breach, New York. 538 p., 504 p.

979. Huyler, Neil K.
1974. **Live-sawing: A way to increase lumber grade yield and mill profits.** USDA For. Serv. Res. Pap. NE-305. 9 p.

980. Huyler, Neil K.
1975. **Tubing vs. buckets: A cost comparison.** USDA For. Serv. Res. Note NE-216. 5 p.

981. Jackson, Lawrence W.
1974. **Honeysuckles.** *In* Shrubs and vines for northeastern wildlife. USDA For. Serv. Gen. Tech. Rep. NE-9. p. 71-82.

982. James, George A.
1971. **Inventorying recreation use.** *In* Recreation symp. proc. USDA For. Serv. Northeast. For. Exp. Stn. p. 78-95.

983. Jensen, K. F.
1966. **A portable gas analyzer.** For. Prod. J. 16:38-39.

984. Jenson, K. F.
1969. **Relationships between the polygalacturonase produced by *Fusarium solani* and pH.** (Abstr.) Phytopathology 59:1033.

985. Jensen, K. F.
1976. **Other asymptomatic physiological and biochemical alterations.** *In* Air pollution and metropolitan woody vegetation. USDA For. Serv. Pinchot Inst. Environ. For. Stud. p. 31-33.

986. Jensen, Keith F.
1967. **Measuring oxygen and carbon dioxide in red oak trees.** USDA For. Serv. Res. Note NE-74. 4 p.

987. Jensen, Keith F.
1967. **Oxygen and carbon dioxide affect the growth of wood-decaying fungi.** For. Sci. 13:384-389.

988. Jensen, Keith F.
1969. **Effect of constant and fluctuating temperature on growth of four wood-decaying fungi.** Phytopathology 59:645-647.

989. Jensen, Keith F.
1969. **Oxygen and carbon dioxide concentrations in sound and decaying red oak trees.** For. Sci. 15:246-251.

990. Jensen, Keith F.
1971. **Cellulolytic enzymes of *Stereum gausapatum*.** Phytopathology 61:134-138.

991. Jensen, Keith F.
1973. **Response of nine forest tree species to chronic ozone fumigation.** Plant Dis. Rep. 57:914-917.

992. Jensen, Keith F.
1974. **Absorption, translocation, and soil deposition of aerial pollutants by vegetation.** *In* Plants, animals and man. Proc. 28th Annu. Meet. Soil Conserv. Soc. Am. p. 26-29.

993. Jensen, Keith F.
1975. **Sulfur content of hybrid poplar cuttings fumigated with sulfur dioxide.** USDA For. Serv. Res. Note NE-209. 4 p.

994. Jensen, Keith F., Frederick W. Bender, and Roberta G. Masters.
1973. **A two-cell chamber for measuring gas exchange in tree seedlings.** USDA For. Serv. Res. Note NE-178. 3 p.

995. Jensen, Keith F., and Leon S. Dochinger.
1972. **Gibberellic acid and height growth of white pine seedlings.** For. Sci. 18:196-197.

996. Jensen, Keith F., and Leon S. Dochinger.
1974. **Responses of hybrid poplar cuttings to chronic and acute levels of ozone.** Environ. Pollut. 6:289-295.

997. Jensen, K. F., L. S. Dochinger, B. R. Roberts, and A. M. Townsend.
1976. **Pollution responses.** *In* Modern methods in forest genetics. Springer-Verlag, Berlin-Heidelberg. p. 189-216.

998. Jensen, Keith F., and Gordon E. Gatherum.
1967. **Height growth of Scotch pine seedlings in relation to prechilling, photoperiod and provenance.** Iowa State J. Sci. 41:425-432.

999. Jensen, K. F., and T. T. Kozlowski.
1974. **Effect of SO_2 on photosynthesis of quaking aspen and white ash seedlings.** (Abstr.) North Am. For. Biol. Workshop Proc. 3:359. Fort Collins, Colo.

1000. Jensen, K. F., and T. T. Kozlowski.
1974. **Sulfur dioxide absorption and**

translocation in forest tree seedlings. (Abstr.) Am. J. Bot. 61(5):28.

1001. Jensen, K. F., and T. T. Kozlowski. 1975. **Absorption and translocation of sulfur dioxide by seedlings of four forest tree species.** J. Environ. Qual. 4:379-382.

1002. Jensen, Keith F., and Roberta G. Masters. 1973. **Effect of defoliation on carbohydrate content of yellow-poplar seedlings.** USDA For. Serv. Res. Note NE-179. 2 p.

1003. Jensen, Keith F., and Roberta G. Masters. 1975. **Growth of six woody species fumigated with ozone.** Plant Dis. Rep. 59:760-762.

1004. Jensen, Keith F., and Phillip E. Reynolds. 1969. **How two types of fluctuating temperature affect the growth of** *Fusarium solani*. USDA For. Serv. Res. Note NE-105. 4 p.

1005. Jensen, Keith F., and Phillip E. Reynolds. 1971. **Response of** *Fusarium solani* **to fluctuating temperatures.** USDA For. Serv. Res. Pap. NE-210. 7 p.

1006. Jensen, Keith F., and Bruce R. Roberts. 1973. **Effects of Fusarium canker on translocation in yellow-poplar seedlings.** Physiol. Plant Pathol. 3:359-361.

1007. Johnson, Leonard R., and Cleveland J. Biller. 1974. **Wood-chipping and a balanced logging system simulation can check the combinations.** Trans. Am. Soc. Agric. Eng. 17:651-655.

1008. Johnson, Leonard R., Donald L. Gochenour, Jr., and Cleveland J. Biller. 1972. **Simulation analysis of timber-harvesting systems.** 23rd Annu. AIIE Conf. & Conv. Tech. Pap. p. 353-361.

1009. Johnson, Noye M., Gene E. Likens, F. H. Bormann, D. W. Fisher, and R. S. Pierce. 1969. **A working model for the variation in streamwater chemistry at the Hubbard Brook Experimental Forest, New Hampshire.** Water Resour. Res. 5:1353-1363.

1010. Johnson, Noye M., Gene E. Likens, F. H. Bormann, and Robert S. Pierce. 1968. **Rate of chemical weathering of silicate minerals in New Hampshire.** Acta Geochimica et Cosmochimica 32:531-545.

1011. Johnson, Roy R. 1975. **Use of herbicides in timber—and reservoir—management programs.** *In* Municipal watershed management symp. proc. USDA For. Serv. Gen. Tech. Rep. NE-13. p. 167-169.

1012. Jones, Jerry K. 1971. **Seasonal recovery of chlorotic needles in Scotch pine.** USDA For. Serv. Res. Pap. NE-184. 9 p.

1013. Jones, Thomas W. 1970. **What about hardwood diseases?** 5th For. Insect and Dis. Work Conf. Proc. p. 201-208.

1014. Jones, Thomas W. 1971. **An appraisal of oak wilt control programs in Pennsylvania and West Virginia.** USDA For. Serv. Res. Pap. NE-204. 15 p.

1015. Jones, Thomas W. 1973. **Killing the oak wilt fungus in logs.** For. Prod. J. 23(11):52-54.

1016. Jones, Thomas W. 1975. **The Dutch elm disease: Challenges and solutions in urbania.** *In* Forestry issues in urban America. Proc. Soc. Am. For. 1974. p. 124-127.

1017. Jones, Thomas W., and Garold F. Gregory. 1971. **An apparatus for pressure injection of solutions into trees.** USDA For. Serv. Res. Pap. NE-233. 7 p.

1018. Jones, Thomas W., Garold F. Gregory, and Percy McWain. 1973. **Pressure injection of solubilized benomyl for prevention and cure of oak wilt.** USDA For. Serv. Res. Note NE-171. 4 p.

1019. Jones, Thomas W., and William R. Phelps.

1972. **Oak wilt.** U.S. Dep. Agric. For. Serv. For. Pest Leafl. 29. (Rev.) 7 p.

1020. Jordan, James S.
1967. **Deer Browsing in northern hardwoods, after clearcutting: Effect on height, density, and stocking of regeneration of commercial species.** USDA For. Serv. Res. Pap. NE-57. 15 p.

1021. Jordan, James S.
1967. **Deer habitat research in Allegheny Plateau forests.** Pa. Fed. Sportsmen's Clubs. 6 p.

1022. Jordan, James S.
1967. **Nutritional aspects in deer browse management.** Wildl. Soc. Northeast. Sect. Annu. Conf. Proc. Quebec. 6 p.

1023. Jordan, James S.
1967. **Response to simulated deer browsing in selected hardwoods.** Trans. Northeast Sect. Wildl. Soc. Northeast Fish Wildl. Conf. January 1964, Hartford, Conn. 13 p.

1024. Jordan, James S.
1968. **Influence of diet in lead poisoning in waterfowl.** Northeast. Fish Wildl. Conf. Trans. 25:143-170.

1025. Jordan, James S.
1970. **Deer habitat management in eastern forests.** J. For. 68:692-694.

1026. Jordan, James S.
1970. **Forest habitat management for nonconsumptive uses of wildlife.** Wildl. Soc. Northeast. Sect. Trans. 27:89-96.

1027. Jordan, James S.
1970. **Pennsylvania's timber and deer resources have been wasted.** Warren Times-Mirror and Observer. 10 Dec. 5(223):B26-B27.

1028. Jordan, James S.
1970. **The timber-deer conflict: A need for understanding.** South. Lumberman 221 (2752): 92-93.

1029. Jordan, James S.
1971. **Dispersal period in a population of eastern fox squirrels (*Sciurus niger*).** USDA For. Serv. Res. Pap. NE-216. 8 p.

1030. Jordan, James S.
1971. **Yield from an intensively hunted population of eastern fox squirrels.** USDA For. Serv. Res. Pap. NE-186. 8 p.

1031. Jordan, James S., and Francis M. Rushmore.
1969. **Animal damage to birch.** *In* Birch symp. proc. USDA For. Serv. Northeast. For. Exp. Stn. p. 155-163.

1032. Jordan, James S., and Ward M. Sharp.
1967. **Seeding and planting hemlock for ruffed grouse cover.** USDA For. Serv. Res. Pap. NE-83. 17 p.

1033. Jorgensen, R. N., and H. O. Fleischer.
1966. **Government wood scientists and technologists.** Soc. Wood Sci. Technol. Log, Aug. p. 2-5.

1034. Jouvenaz, D. P., and R. C. Wilkinson.
1970. **Incidence of *Serratia marescens* in wild *Ips calligraphus* populations in Florida.** J. Invertebr. Pathol. 16:295-296.

1035. Jumper, Gene A., and William N. Cannon, Jr.
1975. **Spermatogenesis in the smaller European elm bark beetle, *Scolytus multistriatus*.** Ann. Entomol. Soc. Am. 68:733-740.

1036. Jumper, Gene A., and William N. Cannon, Jr.
1976. **Chromosome number in the smaller European elm bark beetle,** *Scolytus multistriatus.* Ann. Entomol. Soc. Am. 69:500-502.

1037. Kardos, L. T., and W. E. Sopper.
1973. **Effect of land disposal of wastewater on exchangeable cations and other chemical elements in the soil.** *In* Recycling treated municipal wastewater and sludge through forest and cropland. Pa. State Univ. Press, University Park. p. 220-231.

1038. Keiser, George M.
1974. **A guide to collecting and preserving plants.** USDA For. Serv. Res. Note NE-188. 6 p.

1039. Keiser, George M.
1975. **Using a sugar refractometer.** Natl. Maple Syrup Dig. 14(3):16-17.

1040. Kelso, Elmer G.
1969. **Birch management on the White Mountain National Forest.** *In* Birch symp. proc. USDA For. Serv. Northeast. For. Exp. Stn. p. 165-168.

1041. Kennedy, Bruce H.
1970. *Dendrosoter protuberans* (Hymenoptera: Braconidae) an introduced larval parasite of *Scolytus multistriatus*. Ann. Entomol. Soc. Am. 63:351-358.

1042. Kennedy, Bruce H.
1970. A device for separating and holding small photopositive insects. J. Econ. Entomol. 63:1697-1698.

1043. Kennedy, Bruce H.
1974. Net reproduction of *Dendrosoter protuberans* (Nees), *Spathius benefactor* Matthews and *Cheiropachus colon* (L.) reared on larvae of *Scolytus multistraitus* (Marsham). Proc. North Cent. Branch Entomol. Soc. Am. 29:178-179.

1044. Kennedy, B. H., and J. R. Galford.
1971. Development of *Dendrosoter protuberans* (Nees) on larvae of *Scolytus multistriatus* (Marsham) reared on artificial medium. (Abstr.) Proc. North Cent. Branch Entomol. Soc. Am. 26:91.

1045. Kennedy, Bruce H., and Jimmy R. Galford.
1972. Development of *Dendrosoter protuberans* (Hymenoptera: Braconidae) on larvae of the smaller European elm bark
on
mol

1046. Ken
Rob
197
an
mult
in
Cent
29:1

1047. Ketc
1971
reatic
North

1048. Ketch
1970.
Adiro
serv.

1049. Ketch
1971.
sion
Adiror

1050. Kiang, Y. T., and P. W. Garrett.
1975. Successful rooting of eastern white pine cuttings from a 17-year-old provenance planting. 22nd Northeast. For. Tree Improv. Conf. Proc. p. 24-34.

1051. Kidd, W. J., and J. N. Kochenderfer.
1973. Soil constraints on logging road construction on steep land east and west. J. For. 71(5):284-286.

1052. Kingsley, Neal P.
1966. Pulpwood production in the Northeast—1963. USDA For. Serv. Resour. Bull. NE-3. 26 p.

1053. Kingsley, Neal P.
1967. Pulpwood production in the Northeast—1964. USDA For. Serv. Resour. Bull. NE-5. 27 p.

1054. Kingsley, Neal P.
1968. Pulpwood production in the Northeast—1966. USDA For. Serv. Resour. Bull. NE-11. 33 p.

1055. Kingsley, Neal P.
1971. Pulpwood in the Northeast: Past, present, and future. USDA For. Serv. Resour. Bull. NE-23. 21 p.

1056. Kingsley, Neal P.
1973. The volume of selected hardwood species suitable for turnery olts in Maine—1970. USDA For. erv. Res. Note NE-165. 5 p.

ingsley, Neal P.
974. The timber resources of uthern New England. USDA For. erv. Resour. Bull. NE-36. 50 p.

ingsley, Neal P.
75. The forest-land owners of New rsey. USDA For. Serv. Resour. Bull. E-39. 24 p.

ngsley, Neal P.
76. The forest-land owners of thern New England. USDA For. rv. Resour. Bull. NE-41. 27 p.

gsley, Neal P.
76. The forest resources of New mpshire. USDA For. Serv. Resour. l. NE-43. 71 p.

gsley, Neal P.
6. Research needs related to the re of the forest industry in New land and eastern Canada: Some

land ownership considerations. Yale Ind. For. Semin. Proc. 42:218-221.

1062. Kingsley, Neal P., and Joseph E. Barnard.
1968. **The timber resources of Vermont.** USDA For. Serv. Resour. Bull. NE-12. 117 p.

1063. Kingsley, Neal P., and David R. Dickson.
1967. **Pulpwood production in the Northeast—1965.** USDA For. Serv. Resour. Bull. NE-6. 36 p.

1064. Kingsley, Neal P., and David R. Dickson.
1968. **Timber products production in West Virginia—1965.** USDA For. Serv. Resour. Bull. NE-10. 52 p.

1065. Kingsley, Neal P., and David R. Dickson.
1969. **Pulpwood production in the Northeast—1967.** USDA For. Serv. Resour. Bull. NE-13. 34 p.

1066. Kingsley, Neal P., and James C. Finley.
1975. **The forest-land owners of Delaware.** USDA For. Serv. Resour. Bull. NE-38. 19 p.

1067. Kingsley, Neal P., and Carl E. Mayer.
1970. **The timber resources of Ohio.** USDA For. Serv. Resour. Bull. NE-19. 137 p.

1068. Klawitter, Ralph A.
1970. **Does bedding promote pine survival and growth on ditched wet sands?** USDA For. Serv. Res. Note NE-109. 4 p.

1069. Klawitter, Ralph A.
1970. **Small watershed program: The forest research assessment.** Natl. Watershed Congr. Proc. 17:161-165.

1070. Klawitter, Ralph A.
1970. **Water regulation on forest land.** J. For. 68:338-342.

1071. Klawitter, Ralph A.
1971. **A new thrust against forest pests.** South. Lumberman 222(2756):23-26.

1072. Klawitter, Ralph A.
1972. **Water management in wetland forests of the southeastern United States.** *In* Joint FAO-USSR international symp. on forest influences and watershed management proc. WM/A1789. 19 p.

1073. Klawitter, Ralph A., Keith K. Young, and James M. Case.
1971. **Potential site index for wet pineland soils of the Coastal Plain.** USDA For. Serv. Southeast. Area, State and Priv. For. 20 p.

1074. Klein, William H., and Franklin B. Lewis.
1966. **Experimental spraying with *Bacillus thuringiensis* for control of the spruce budworm.** J. For. 64:458-462.

1075. Kleiner, Gail F., and John W. Peacock.
1971. **Amino acids in the haemolymph of smaller European elm bark beetle larvae, *Scolytus multistriatus* (Marsham) (Coleoptera: Scolytidae).** Ohio J. Sci. 71(1):36-43.

1076. Knierim, Philip G., Kenneth L. Carvell, and John D. Gill.
1971. **Browse in thinned oak and cove hardwood stands.** J. Wildl. Manage. 35:163-168.

1077. Knight, P. B.
1969. **Some practical field problems associated with sampling of scarce insects.** *In* Forest insect population dynamics. USDA For. Serv. Res. Pap. NE-125. p. 89-96.

1078. Knutson, Robert.
1970. **A look at the mine-timber market in the Appalachian bituminous coal region.** USDA For. Serv. Res. Pap. NE-147. 9 p.

1079. Knutson, Robert G.
1971. **Getting a start on exporting.** North. Logger 19(8):21,36.

1080. Knutson, Robert G.
1975. **The highway market for mulch: An opportunity for bark producers.** North. Logger 23(12):13,32-33.

1081. Knutson, Robert G.
1975. **Trends in the highway market for wood products.** USDA For. Serv. Res. Note NE-210. 4 p.

1082. Kochenderfer, J. N.
1971. **Soil moisture under white pine and mixed hardwood forests.** Trans. Am. Geophys. Union 52(4):201.

1083. Kochenderfer, James N.
1970. **Erosion control on logging roads.** Proc. For. Eng. Workshop on For. Roads. W. Va. Univ. 71 (1-4):10.

1084. Kochenderfer, James N.
1970. **Erosion control on logging roads in the Appalachians.** USDA For. Serv. Res. Pap. NE-158. 28 p.

1085. Kochenderfer, James N.
1971. **Erosion control on logging roads.** N.Y. For. 28(1):8.

1086. Kochenderfer, James N.
1971. **Some hydrologic effects of clearcutting forested watersheds.** (Abstr.) W. Va. Geobotany Conf. Proc. 3.

1087. Kochenderfer, James N.
1973. **Root distribution under some forest types native to West Virginia.** Ecology 54:445-448.

1088. Kochenderfer, James N., and Gerald M. Aubertin.
1975. **Effect of management practices on water quality and quantity: Fernow Experimental Forest, West Virginia.** *In* Municipal watershed management symp. proc. USDA For. Serv. Gen. Tech. Rep. NE-13. p 14-24.

1089. Kochenderfer, J., and R. Lee.
1973. **Indexes to transpiration by forest trees.** Ecol. Plant. 8:175-184.

1090. Kochenderfer, James N., and James H. Patric.
1970. **Effects of clearcutting—past and present—on water resources of the Monongahela National Forest.** W. Va. Agric. For. 3(3):5-11.

1091. Koelling, Melvin R.
1967. **A portable field shelter.** USDA For. Serv. Res. Note NE-70. 4 p.

1092. Koelling, Melvin R.
1968. **Determining sap sweetness in small sugar maple trees.** USDA For. Serv. Res. Note NE-76. 4 p.

1093. Koelling, Melvin R.
1968. **Rooting ability of sugar maple cuttings depends on date of collection in each region.** Tree Plant. Notes 19(1):20-22.

1094. Koelling, Melvin R.
1968. **Sap yields from fall and spring tapping of sugar maple.** USDA For. Serv. Res. Pap. NE-115. 8 p.

1095. Koelling, Melvin R., and Barton M. Blum.
1967. **Controlling taphole depth in maple sap production research.** USDA For. Serv. Res. Note NE-61. 4 p.

1096. Koelling, M. R., B. M. Blum, and C. B. Gibbs
1968. **Fall sap-sugar percentages: A guide for cultural operations in the sugarbush.** North. Logger 16(10:24, 26).

1097. Koelling, Melvin R., Barton M. Blum, and Carter B. Gibbs
1968. **A summary and evaluation of research on the use of plastic tubing in maple sap production.** USDA For. Serv. Res. Pap. NE-116. 12 p.

1098. Koelling, Melvin R., and William J. Gabriel.
1966. **Selection and propagation of superior sugar maple trees.** Natl. Maple Syrup Dig. 5(2):6-8.

1099. Koenick, Leonard J., and E. George Stern.
1968. **Load-carrying capacity of short flooring strips.** Va. Polytech. Inst. Res. Div. Wood Res. and Wood Constr. Lab. Misc. Bull. 75. 8 p.

1100. Konar, R. N.
1974. **In vitro studies on *Pinus*. I. Establishment and growth of callus.** Physiol. Plant. 32:193-197.

1101. Konar, R. N.
1975. **In vitro studies on *Pinus*. II. The growth and morphogenesis of cell cultures from Pinus gerardiana.** Phytomorphology 25:55-59.

1102. Kopcewicz, J., and Z. Poraziński.
1973. **Influence of low temperature on germination and endogenous growth regulator contents in Scots pine *(Pinus silvestris* L.) seeds.** Acta Soc. Bot. Pol. 42:233-244.

1103. Kopcewicz, J., and Z. Poraziński.
1976. **Effect of blue light irradiation on metabolism of free and bound gibberellins in Scots pine (*Pinus silvestris* L.).** Acta Univ. Nicolai Copernici Biol. Nauki Math.-Przyr. 37:203-207.

1104. Kottke, Marvin W., Malcom I. Bevins, Gerald L. Cole, Kenneth J. Hock, and Wilbur F. LaPage.
1975. **Analysis of the campground market in the Northeast.** Report III. A perspective on the camping-involvement cycle. USDA For. Serv. Res. Pap. NE-322. 35 p.

1105. Kozlowski, T. T.
1976. **Drought and transplantability of trees.** *In* Better trees for metropolitan landscapes symp. proc. USDA For. Serv. Gen. Tech. Rep. NE-22. p. 77-90.

1106. Krause, H. H.
1973. **Forest fertilization in eastern Canada, with emphasis on New Brunswick studies.** *In* Forest fertilization symp. proc. USDA For. Serv. Gen. Tech. Rep. NE-3. p. 188-205.

1107. Krawczszyn, J.
1973. **Domain pattern in the cambium of young *Platanus* stems.** Acta Soc. Bot. Pol. 42:637-648.

1108. Krawczszyn, J., and J. A. Romberger.
1975. **Wood grain patterns allow study of the time aspect of slowly migrating morphogenic waves in cambia trees.** Chronobiologia 2: Suppl. 1:38-39. (Abstr., Soc. Chronobiology Int. Conf. 12, Washington, D.C.).

1109. Kriebel, H. B., and W. J. Gabriel.
1969. **Genetics of sugar maple.** USDA For. Serv. Res. Pap. WO-7. 17 p.

1110. Kriebel, H. B., H. C. Larrson, and W. J. Gabriel.
1967. **Report of the NEFTIC Hardwood Improvement Committee.** 14th Northeast. For. Tree Improv. Conf. Proc. p. 76-87.

1111. Kriesel, K., and M. Michniewicz.
1974. **The mutual influence of roots and shoots on gibberellin production.** Acad. Pol. Sci. Ser. Biol. Bull. 22:507-512.

1112. Krochmal, Arnold.
1968. **Medicinal plants and Appalachia.** Econ. Bot. 22:332-337.

1113. Krochmal, Arnold.
1968. **Papaya diseases of tropical America.** World Crops, June. p. 40-41.

1114. Krochmal, Arnold.
1969. **Deer's tongue, *Trilisa odoratissima*, a useful plant of Southeastern United States.** Econ. Bot. 23:185-186.

1115. Krochmal, Arnold.
1969. **Low volume papaya processing in Surinam.** World Crops, March/April. p. 22-23.

1116. Krochmal, Arnold.
1969. **Propagation of cassava.** World Crops, July/August. p. 193-195.

1117. Krochmal, Arnold
1970. **Germinating pokeberry seed (*Phytolacca americana* L.).** USDA For. Serv. Res. Note NE-114. 4 p.

1118. Krochmal, Arnold.
1972. **Medicinal values.** *In* Wildland shrubs: Their biology and utilization. USDA For. Serv. Gen. Tech. Rep. INT-1. p. 98-100.

1119. Krochmal, Arnold.
1974. **Some common diseases of papaya.** CEIBA 18(1-2):19-31.

1120. Krochmal, Arnold, and Morris R. Henderson.
1970. **Empaque y embarque aereo de papayas.** La Hacienda, December. p. 35-36.

1121. Krochmal, Arnold, and Juanita Huguely.
1970. **Research of importance to the Christmas tree industry.** Am. Christmas Tree J. 14(2):17-21.

1122. Krochmal, Arnold, and Juanita Huguely.
1971. **Seed descriptions of four common lobelias.** Castanea 36:257-259.

1123. Krochmal, Arnold, and P. W. LeQuesne.
1970. **Pokeweed (*Phytolacca americana*): Possible source of a molluscicide.** USDA For. Serv. Res. Pap. NE-177. 8 p.

1124. Krochmal, Arnold, and Karyl Magee.
1971. **A population of *Lobelia inflata* L.** Castanea 36:71-76.

1125. Krochmal, Arnold, and George Samuels.

1968. **Deficiency symptoms in nutrient pot experiments with Cassava.** CEIBA 14(1):7-15.

1126. Krochmal, Arnold, Russell S. Walters, and Richard M. Doughty.
1969. **A guide to medicinal plants of Appalachia.** USDA For. Serv. Res. Pap. NE-138. 291 p.

1127. Krochmal, Arnold, and Leon Wilken.
1970. **The culture of Indian tobacco** *(Lobelia inflata* **L.).** USDA For. Serv. Res. Pap. NE-181. 9 p.

1128. Krochmal, Arnold, Leon Wilken, and Millie Chien.
1970. **Lobeline content of lobelia inflata: Structural, environmental, and developmental effects.** USDA For. Serv. Res. Pap. NE-178. 13 p.

1129. Krochmal, Arnold, Leon Wilken, and Millie Chien.
1972. **Lobeline content of four Appalachian lobelias.** Lloydia 35:303-304.

1130. Krochmal, Arnold, Leon Wilken, David Van Lear, and Millie Chien.
1974. **Mayapple.** USDA For. Serv. Res. Pap. NE-296. 8 p.

1131. Krugman, S. L., W. I. Stein, and D. M. Schmitt.
1974. **Seed biology.** *In* Seeds of woody plants in the United States. U.S. Dep. Agric., Agric. Handb. 450. p. 5-40.

1132. Lamson, Neil I.
1976. **Appalachian hardwood stump sprouts are potential sawlog crop trees.** USDA For. Serv. Res. Note NE-229. 4 p.

1133. Lancaster, Kenneth F., and Russell S. Walters.
1974. **How to hang plastic tubing to collect maple sap.** USDA For. Serv. Northeast. Area, State and Priv. For. 6 p.

1134. Lancaster, Kenneth F., Russell S. Walters, Frederick M. Laing, and Raymond T. Foulds.
1974. **A silvicultural guide for developing a sugarbush.** USDA For. Serv. Res. Pap. NE-286. 11 p.

1135. Lane, Richard D.
1967. **Cooperative strip mine research.** Ky. Dep. Nat. Resour. Strip. Min. Symp. Proc. 2 p.

1136. Lane, Richard D.
1968. **Forest Service reclamation research.** Min. Congr. J. 54(5):38-42.

1137. Lane, Richard.
1968. **[Strip mining.]** Natl. Inst. Nat. Resour. Law Proc. Frankfort, Ky. p. 37-39.

1138. Lane, Richard.
1970. **Research role in environmental forestry.** USDA For. Serv. Northeast. Area, State and Priv. For. Annu. Meet. Proc. 5. p. 32-33.

1139. Lanier, G. N.., R.M. Silverstein, and J. W. Peacock
1976. **Attractant pheromone of the European elm bark beetle** *(Scolytus multistriatus):* **isolation, identification, synthesis, and utilization studies.** *In* Perspectives in forest entomology, J. F. Anderson and H. K. Kaya, eds. Academic Press, New York. p. 149-176.

1140. LaPage, W. F.
1968. **Some implications of recreation markets for rural economies.** Sociol. Abstr. Suppl. 2, 16(7):67, 70.

1141. LaPage, W. F.
1970. **Campground and camper market research.** Trends in Parks and Recreation 7(1):7-12.

1142. LaPage, W. F.
1970. **Campground and camper market research.** Family Camping Leader 7(3):1-8.

1143. LaPage, W. F.
1970. **Meeting the social needs of tomorrow's campers.** Planning Tomorrow's Campground Workshop Proc. Univ. Vt. Ext. Serv. Brief. 1197. p. 6-18.

1144. LaPage, W. F.
1973. **Growth potential of the family camping market.** USDA For. Serv. Res. Pap. NE-252. 25 p.

1145. LaPage, W. F.
1973. **Market research models for outdoor recreation development planning.** Travel Res. Assoc. 4th Annu. Conf., Sun Valley, Idaho. 10 p.

1146. LaPage, W. F.
1976. **New roles for government and industry in outdoor recreation.** *In* Proc. South. States Recreation Res. Appl. Workshop. USDA For. Serv. Gen. Tech. Rep. SE-9. p. 218-227.

1147. LaPage, Wilbur F.
1966. **Success of campgrounds studied as guide to recreation planning.** USDA For. Serv. Res. Note NE-43. 7 p.

1148. LaPage, Wilbur F.
1967. **Camper characteristics differ at public and commercial campgrounds in New England.** USDA For. Serv. Res. Note NE-59. 8 p.

1149. LaPage, Wilbur F.
1967. **Recreation research and public land management goals.** Proc. Annu. Winter Meet. N.Y. Sec. Soc. Am. For. [N.Y. For. 24(3):26].

1150. LaPage, Wilbur F.
1967. **Review of "Economics of outdoor recreation," by Marion Clawson and Jack L. Knetsch.** Rural Sociol. 32(4):478-479.

1151. LaPage, Wilbur F.
1967. **Some observations on campground trampling and ground cover response.** USDA For. Serv. Res. Pap. NE-68. 11 p.

1152. LaPage, Wilbur F.
1967. **The successful campground formula.** Family Camping Area Manage. Conf. Proc. Cornell Univ., Ithaca, N.Y. p. 35-52.

1153. LaPage, Wilbur F.
1967. **Successful private campgrounds: A study of factors that influence the length and frequency of camper visits.** USDA For. Serv. Res. Pap. NE-58. 23 p.

1154. LaPage, Wilbur F.
1968. **The role of customer satisfaction in managing commercial campgrounds.** USDA For. Serv. Res. Pap. NE-105. 23 p.

1155. LaPage, Wilbur F.
1968. **The role of fees in campers' decisions.** USDA For. Serv. Res. Pap. NE-118. 24 p.

1156. LaPage, Wilbur F.
1969. **The camper views the interview.** J. Leisure Res. 1:181-186.

1157. LaPage, Wilbur F.
1969. **Campground marketing: The heavy-half strategy.** USDA For. Serv. Res. Note NE-93. 6 p.

1158. LaPage, Wilbur F.
1969. **The family camping phenomenon: Motivation, ways and means, accommodations.** Southeast. Park Recreation Train. Inst. Plann. Maint. Oper. Proc. 14. p. 14-19.

1159. LaPage, Wilbur F.
1970. **The mythology of outdoor recreation planning.** South. Lumberman 221(2752):118-121.

1160. LaPage, Wilbur F.
1971. **Cultural "fogweed" and outdoor recreation research.** *In* Recreation symp. proc. USDA For. Serv. Northeast. For. Exp. Stn. p. 186-193.

1161. LaPage, Wilbur F.
1972. **Understanding camping market growth.** Family Camping. Fed. Am. Camping Congr. Annu. Résumé 2. 14

1162. LaPage, Wilbur F.
1973. **New Hampshire's commercial campgrounds.** N.H. For. Notes 115. p. 20-22.

1163. LaPage, Wilbur F.
1974. **Market research: The missing link in resource-development planning for outdoor recreation.** *In* Outdoor recreation research: Applying the results. USDA For. Serv. Gen. Tech. Rep. NC-9. p. 107-113.

1164. LaPage, Wilbur F., Paula L. Cormier, George T. Hamilton, and Alan D. Cormier.
1975. **Differential campsite pricing and campground attendance.** USDA For. Serv. Res. Pap. NE-330. 6 p.

1165. LaPage, Wilbur F., Paula L. Cormier, and Steven C. Maurice.
1972. **The commercial campground industry in New Hampshire: A report on a 1971 campground census.** USDA For Serv. Res. Pap. NE-255. 41 p.

1166. LaPage, Wilbur F., and Edward G. Fisher.

1971. **Geographical variation in camper expenditures.** USDA For. Serv. Res. Note NE-139. 8 p.

1167. LaPage, W. F., and A. C. Haaland.
1974. **Annotated bibliography of camping market surveys.** USDA For. Serv. Gen. Tech. Rep. NE-11. 39 p.

1168. LaPage, Wilbur F., Walter S. Hopkins, and J. Richard Williams.
1973. **Hey, just look what's happened to camping!** *In* Handbook for the Home. U.S. Dep. Agric. Yearb. 1973. p. 66-71.

1169. LaPage, W. F., and Dale P. Ragain.
1970. **Trends in camping participation.** (Abstr.) Sociol. Abstr. 18(5):902.

1170. LaPage, Wilbur F., and Dale P. Ragain.
1971. **A second look at the heavy half of the camping market.** USDA For. Serv. Res. Pap. NE-196. 9 p.

1171. LaPage, Wilbur F., and Dale P. Ragain.
1971. **Trends in camping participation.** USDA For. Serv. Res. Pap. NE-183. 22 p.

1172. LaPage, Wilbur F., and Dale P. Ragain.
1972. **Campground marketing: The impulse camper.** USDA For. Serv. Res. Note NE-150. 4 p.

1173. LaPage, W. F., and D. P. Ragain.
1974. **Family camping trends: An eight-year panel study.** J. Leisure Res. 6:101-112.

1174. Large, H. R., H. A. Core, G. R. Wells, and W. E. Duggans.
1971. **Hardwood flooring yields from Appalachian red oak lumber.** Univ. Tenn. Agric. Exp. Stn. Bull. 484. 20 p.

1175. Large, Hollis R., and Richard E. Frost.
1973. **Quality distribution of pallet parts from low-grade lumber.** USDA For. Serv. Res. Pap. NE-284. 8 p.

1176. Larsen, David N., and David A. Gansner.
1972. **Pennsylvania's private woodland owners: A study of the characteristics, attitudes, and actions of an important group of decisionmakers.** USDA For. Serv. Res. Pap. NE-219. 17 p.

1177. Larsen, David N., and David A. Gansner.
1973. **Explaining the forest product selling behavior of private woodland owners.** USDA For. Serv. Res. Pap. NE-257. 4 p.

1178. Larsen, David N., and David A. Gansner.
1975. **Pennsylvania's private woodland owners: An important group of decisionmakers.** Pa. For. 66:10-12.

1179. Larsen, David N., and David A. Gansner.
1975. **Simple models for estimating local removals of timber in the Northeast.** USDA For. Serv. Res. Pap. NE-319. 7 p.

1180. Larson, Edwin vH.
1969. **A girl-watcher looks at the birches.** USDA For. Serv. Northeast. For. Exp. Stn. 4 p.

1181. Larson, Edwin vH.
1971. **A guide for authors of symposium papers.** USDA For. Serv. Res. Note NE-144. 7 p.

1182. Larson, Joseph S.
1974. **Serviceberries.** *In* Shrubs and vines for northeastern wildlife. USDA For. Serv. Gen. Tech. Rep. NE-9. p. 126-128.

1183. Lautenschlager, R. A., and Gerard J. Hennessey.
1975. **Some advantages of a track-pellet-group technique for estimating deer numbers.** Trans. Northeast. Fish Wildl. Conf. New Haven, Conn. 32:13-24.

1184. Lazarus, H., W. Tegeler, H. M. Mazzone, J. C. Leroy, B. A. Boone, and G. E. Foley.
1966. **Determination of sensitivity of individual biopsy specimens to potential inhibiting agents: Evaluation of some explant culture methods as assay systems.** Cancer Chemother. Rep. 50:543-555.

1185. Leaf, Albert L., J. V. Berglund, and R. E. Leonard.
1970. **Annual variation in fertilized and/or irrigated red pine plantations.** Soil Sci. Soc. Am. Proc. 34:677-682.

1186. Leaf, Albert L., and Raymond E. Leonard.
1967. **Forest fertilization, irrigation, and environment.** South. Lumberman 215(2680):163-165.

1187. Leaf, Albert L., and Raymond E. Leonard.
1967. **Measurement of environmental characteristics of a forest stand.** 14th IUFRO Congr. Sect. 21. p. 282-297.

1188. Leaf, Albert L., and Raymond E. Leonard.
1969. **Forest fertilization, the environment, and total dry-matter production.** South. Lumberman 219(2720):24-26.

1189. Leaf, Albert L., and Raymond E. Leonard.
1970. **Forest fertilization and/or water quality?** South. Lumberman 221(2752):90-91.

1190. Leaf, Albert L., and Raymond E. Leonard.
1971. **A rational approach to forest treatments.** South. Lumberman 223(2776):169.

1191. Leaf, Albert L., and R. E. Leonard.
1974. **Fertilization in an environmental context.** South. Lumberman 229(2848):88.

1192. Leaf, Albert L., Raymond E. Leonard, and John V. Berglund.
1971. **Root distribution of a plantation-grown red pine in an outwash soil.** Ecology 52:153-158.

1193. Leaf, Albert L., Raymond E. Leonard, John V. Berglund, Arthur R. Eschner, Patric H. Cochran, James B. Hart, Jr., Giles M. Marion, and Richard A. Cunningham.
1970. **Growth and development of *Pinus resinosa* plantations subjected to irrigation-fertilization treatments.** *In* Tree growth and forest soils. Proc. 3rd North Am. For. Soils Conf. p. 97-118.

1194. Leaf, A. L., R. E. Leonard, and N. A. Richards.
1975. **Forest fertilization for non-wood production benefits in northeastern U.S.** *In* Forest soils and forest land management. Proc. 4th North Am. For. Soils Conf. p. 435-448.

1195. Leak, W. B.
1969. **Stocking of northern hardwood regeneration based on exponential dropout rate.** For. Chron. 45:344-347.

1196. Leak, W. B.
1973. **Species and structure of a virgin northern hardwood stand in New Hampshire.** USDA For. Serv. Res. Note NE-181. 4 p.

1197. Leak, W. B.
1974. **Review of "Systems analysis and simulation in ecology."** Ecology 55:678-679.

1198. Leak, W. B.
1975. **Age distribution in virgin red spruce and northern hardwoods.** Ecology 56:1451-1454.

1199. Leak, W. B.
1976. **Relation of tolerant species to habitat in the White Mountains of New Hampshire.** USDA For. Serv. Res. Pap. NE-351. 10 p.

1200. Leak, William B.
1966. **Analysis of multiple systematic remeasurements.** For. Sci. 12:69-73.

1201. Leak, William B.
1968. **Birch regeneration: A stochastic model.** USDA For. Serv. Res. Note NE-85. 7 p.

1202. Leak, William B.
1969. **Financial maturity of yellow birch.** *In* Birch symp. proc. USDA For. Serv. Northeast. For. Exp. Stn. p. 145-146.

1203. Leak, William B.
1970. **Sapling stand development: A compound exponential process.** For. Sci. 16:177-180.

1204. Leak, William B.
1970. **Some preliminary estimates of energy utilization in even-aged northern hardwoods.** USDA For. Serv. Res. Note NE-108. 7 p.

1205. Leak, William B.
1970. **Successional change in northern hardwoods predicted by birth and death simulation.** Ecology 51:794-801.

1206. Leak, William B.
1971. Simulation of forest succession. Summer Comput. Simulation Conf. 1971. Boston. p. 820-825.

1206a. Leak, William B.
1972. Competitive exclusion in forest trees. Nature 236(5340):461-462.

1207. Leak, William B.
1972. Review of "Systems ecology." Ecology 53:199-200.

1208. Leak, William B.
1974. Elevation vs. tree development. N.H. For. Notes 119. p. 24-25.

1209. Leak, William B.
1974. Some effects of forest preservation. USDA For. Serv. Res. Note NE-186. 4 p.

1210. Leak, William B.
1976. Systems analysis III. Ecology 57:403-404.

1211. Leak, William B., Peter H. Allen, James P. Barrett, Frank K. Beyer, Donald L. Mader, Joseph C. Mawson, and Robert K. Wilson.
1970. Yields of eastern white pine in New England related to age, site, and stocking. USDA For. Serv. Res. Pap. NE-176. 15 p.

1212. Leak, William B., and Stanley M. Filip.
1970. Cutting strategies and timber yields for unbalanced even-aged northern hardwood forests. USDA For Serv. Res. Pap. NE-153. 19 p.

1213. Leak, William B., and Stanley M. Filip.
1975. Uneven-aged management of northern hardwoods in New England. USDA For. Serv. Res. Pap. NE-332. 15 p.

1214. Leak, William B., Stanley M. Filip, and Dale S. Solomon.
1968. Rates of value increase for yellow birch in New England. USDA For. Serv. Res. Pap. NE-120. 10 p.

1215. Leak, William B., and Raymond E. Graber.
1974. Forest vegetation related to elevation in the White Mountains of New Hampshire. USDA For. Serv. Res. Pap. NE-299. 7 p.

1216. Leak, W. B., and R. E. Graber.
1974. A method for detecting migration of forest vegetation. Ecology 55:1425-1427.

1217. Leak, William B., and Raymond E. Graber.
1976. Seedling input, death, and growth in uneven-aged northern hardwoods. Can. J. For. Res. 6:368-374.

1218. Leak, William B., and C. Wayne Martin.
1975. Relationship of stand age to streamwater nitrate in New Hampshire. USDA For. Serv. Res. Note NE-211. 5 p.

1219. Leak, W. B., and D. S. Solomon.
1975. Influence of residual stand density on regeneration of northern hardwoods. USDA For. Serv. Res. Pap. NE-310. 7 p.

1220. Leak, William B., Dale S. Solomon, and Stanley M. Filip.
1969. A silvicultural guide for northern hardwoods in the Northeast. USDA For. Serv. Res. Pap. NE-143. 34 p.

1221. Lederer, Robert F.
1976. The challenge: An industry together. *In* Better trees for metropolitan landscapes symp. proc. USDA For. Serv. Gen. Tech. Rep. NE-22. p. 253-256.

1222. Ledig, F. T., R. W. Wilson, J. W. Duffield, and G. Maxwell.
1969. A discriminant analysis of introgression between ***Quercus prinus*** **L. and** ***Quercus alba*** **L.** Torrey Bot. Club Bull. 96:156-163.

1223. Leonard, David E.
1971. Population quality. *In* Toward integrated control. Proc. 3rd Annu. Northeast. For. Insect Work Conf. USDA For. Serv. Res. Pap. NE-194. p. 7-20.

1224. Leonard, Raymond E.
1967. Mathematical theory of interception. *In* International symp. on forest hydrology proc. Pergamon Press, Oxford, England. p. 131-136.

1225. Leonard, Raymond E.
1969. **Forests and noise abatement.** Soc. Am. For. Annu. Meet. (1968) Abstr. Pap. 27.

1226. Leonard, Raymond E.
1971. **Effects of trees and forests in noise abatement.** *In* Trees and forests in an urbanizing environment. Univ. Mass. Coop. Ext. Serv. Plann. and Resour. Dev. Ser. 17. p. 35-38.

1227. Leonard, Raymond E.
1972. **Making our lives more pleasant: Plants as climate changers.** *In* Landscape for living. U.S. Dep. Agric. Yearb. 1972. p. 5-9.

1228. Leonard, Raymond E., and Arthur R. Eschner.
1968. **Albedo of intercepted snow.** Water Resour. Res. 4:931-935.

1229. Leonard, Raymond E., and Arthur R. Eschner.
1968. **A treetop tramway system for meteorological studies.** USDA For. Serv. Res. Pap. NE-92. 10 p.

1230. Leonard, R. E., and C. A. Federer.
1972. **Soil microclimate.** 1st Soil Microcommunities Conf. Proc. 711018. p. 8-18.

1231. Leonard, R. E., and C. A. Federer.
1973. **Estimated and measured roughness parameters for a pine forest.** J. Appl. Meteorol. 12:302-307.

1232. Leonard, R. E., and L. P. Herrington.
1971. **Noise abatement in a pine plantation.** USDA For. Serv. Res. Note NE-140. 6 p.

1233. Leonard, Raymond E., Albert L. Leaf, and John V. Berglund.
1972. **The role of forest site in fertilizer response.** USDA For. Serv. Res. Pap. NE-243. 7 p.

1234. Leonard, Raymond E., Albert L. Leaf, John V. Berglund, and Phillip J. Craul.
1971. **Annual soil moisture-temperature patterns as influenced by irrigation.** Soil Sci. 3:220-227.

1235. Leonard, Raymond E., and Sally B. Parr.
1970. **Trees as a sound barrier.** J. For. 68:282-283.

1236. Lesser, Walter A., and Jean D. Wistendahl.
1974. **Dogwoods.** *In* Shrubs and vines for northeastern wildlife. USDA For. Serv. Gen. Tech. Rep. NE-9. p. 32-41.

1237. Leuschner, William A., and Roscoe B. Herrington.
1971. **The Skier: His characteristics and preferences.** *In* Recreation symp. proc. USDA For. Serv. Northeast. For. Exp. Stn. p. 135-142.

1238. Lewis, F. B.
1975. **Dosage effect on target insect populations (short- and long-term).** *In* Baculoviruses for pest control: Safety considerations, M. Summers, ed. Am. Soc. Microbiol. p. 143-144.

1239. Lewis, Franklin B.
1971. **Mass propagation of insect viruses with specific reference to forest insects.** 4th Int. Colloq. Insect Pathol. p. 320-326.

1240. Lewis, Franklin B., and Donald P. Connola.
1966. **Field and laboratory investigations of *Bacillus Thuringiensis* as a control agent for gypsy moth, *Porthetria dispar* (L.).** USDA For. Serv. Res. Pap. NE-50. 38 p.

1241. Lewis, F. B., and L. Daviault.
1967. **Gypsy moth *Porthetria dispar* (L.).** *In* Important forest insects and diseases of mutual concern to Canada, the United States and Mexico. Can. Dep. For. Rural Dev. Publ. 1180. p. 152-156.

1242. Lewis, F. B., N. R. Dubois, D. Grimble, W. Metterhouse, and J. Quimby.
1974. **Gypsy moth: Efficacy of aerially-applied *Bacillus thuringiensis.*** J. Econ. Entomol. 351-354.

1243. Lewis, F. B., and A. R. Hastings.
1967. **Mass rearing of the European pine sawfly, *Neodiprion sertifer* Geoff., for the production of large quantities of the nuclear polyhedral virus.** USDA Northeast. For. Exp. Stn. 6 p.

1244. Lewis, W. C., and B. G. Heebink.
1971. **Reconstituted products from oak.** *In* Oak symp. proc. USDA For. Serv. Northeast. For. Exp. Stn. p. 106-110.

1245. Lewis, W. J., Richard L. Jones, Donald A. Nordlund, and H. R. Gross, Jr.
1976. **Kairomones and their role in pest management.** *In* Proc. of the eighth annual northeastern forest insect work conference. USDA For. Serv. Gen. Tech. Rep. NE-27. p. 7-14.

1246. Likens, Gene E., F. H. Bormann, and Noye M. Johnson.
1969. **Nitrification: Importance to nutrient losses from a cutover forested ecosystem.** Science 163:1205-1206.

1247. Likens, Gene E., F. Herbert Bormann, Noye M. Johnson, D. W. Fisher, and Robert S. Pierce.
1970. **Effects of forest cutting and herbicide treatment on nutrient budgets in the Hubbard Brook watershed-ecosystem.** Ecol. Monogr. 40:23-47.

1248. Likens, G. E., F. H. Bormann, N. M. Johnson, and R. S. Pierce.
1967. **The calcium, magnesium, potassium and sodium budgets for a small forested ecosystem.** Ecology 48:772-785.

1249. Lime, David W., and George H. Stankey.
1971. **Carrying capacity: Maintaining outdoor recreation quality.** *In* Recreation symp. proc. USDA For. Serv. Northeast. For. Exp. Stn. p. 174-184.

1250. Lincoln, A. Charles.
1967. **The status of systemic insecticides for shade tree insect control.** Natl. Arborists Assoc. 16th Mid-Winter Proc. p. 48-55.

1251. Lincoln, A. Charles.
1968. **Insect research at the Delaware Laboratory.** Trees Mag. 28(2):14-17.

1252. Lincoln, A. Charles.
1969. **The Dutch elm disease research program in the U.S. Forest Service.** Tree Wardens, Arborists, and Utilities Conf. Proc. Univ. Mass., Amherst. p. 138-147.

1253. Lindmark, Ronald D., and Paul S. DeBald.
1969. **Black walnut on nonforest land in Kentucky.** USDA For. Serv. Resour. Bull. NE-16. 18 p.

1254. Liscinsky, Stephen A.
1974. **Gray dogwood.** *In* Shrubs and vines for northeastern wildlife. USDA For. Serv. Gen. Tech. Rep. NE-9. p. 42-43.

1255. Little, Elbert L., Jr., Silas Little, and Warren T. Doolittle.
1967. **Natural hybrids among pond, loblolly, and pitch pines.** USDA For. Serv. Res. Pap. NE-67. 22 p.

1256. Little, S.
1966. **Mistblower application of herbicides in multiple-use forestry.** Northeast. Weed Control Conf. Proc. 20 (suppl.). 4 p.

1257. Little, S.
1969. **Local seed sources recommended for loblolly pine in Maryland and shortleaf pine in New Jersey and Pennsylvania.** USDA For. Serv. Res. Pap. NE-134. 16 p.

1258. Little, Silas.
1967. **Japanese honeysuckle: Persistent use of herbicides required to combat this robust immigrant.** *In* Weed control in the home garden: A handbook. Brooklyn Bot. Gard. Plants & Gard. 22(3):62-63.

1259. Little, Silas.
1967. **Treatments needed to regenerate yellow-poplar in New Jersey and Maryland.** USDA For. Serv. Res. Note NE-58. 8 p.

1260. Little, Silas.
1971. **Protect homes from forest fires.** Rutgers Univ. Coll. Agric. Environ. Sci. Coop. Ext. Serv. Ext. Bull. 401. 8 p.

1261. Little, Silas.
1972. **Growth of planted white pines and pitch pine seedlings in a South Jersey plains area.** N.J. Acad. Sci. Bull. 17(2):18-23.

1262. Little, Silas.
1972. Review of "Tree maintenance." J. For. 70:640.

1263. Little, Silas.
1973. **Eighteen-year changes in the composition of a stand of *Pinus echinata* and *P. rigida* in southern New**

Jersey. Torrey Bot. Club Bull. 100:94-102.

1264. Little Silas.
1973. **Survival, growth of loblolly, pitch, shortleaf pines established by different methods in New Jersey.** Tree Plant. Notes 24(4):1-5.

1265. Little, Silas.
1973. **Use of fire: Comments from the Northeast.** J. For. 71:633-634.

1266. Little, Silas.
1974. *Ailanthus altissima* **(Mill.) Swingle: Ailanthus.** *In* Seeds of woody plants in the United States. U.S. Dep. Agric., Agric. Handb. 450. p. 201-202.

1267. Little, Silas.
1974. **Effects of fire on temperate forests: Northeastern United States.** *In* Fires and ecosystems. Academic Press, New York. p. 225-250.

1268. Little, Silas.
1974. **Review of "Vegetation of New Jersey."** Torrey Bot. Club Bull. 101:36.

1269. Little, Silas.
1974. **Wildflowers of the pine barrens and their niche requirements.** N.J. Outdoors 1(3):17-18.

1270. Little, Silas.
1975. **Japanese honeysuckle: Persistent efforts required to combat this robust immigrant.** *In* Weed control in the home garden: A handbook. Brooklyn Bot. Gard. Plants & Gard. 31(2):55.

1271. Little, Silas.
1975. **Review of "Handbook of vegetation science. Part V. Ordination and classification of communities. Part VIII. Vegetation dynamics."** Torrey Bot. Club Bull. 102:79-80.

1272. Little, Silas, Donald E. Beck, and Lino Della-Bianca.
1973. **Eastern white pine.** *In* Silvicultural systems for the major forest types of the Unites States. U.S. Dep. Agric., Agric. Handb. 445. p. 73-75.

1273. Little, Silas, Calvin F. Bey, and Daniel McConaughy.
1974. **Local sources of black walnut recommended for planting in Maryland.** USDA For. Serv. Res. Note NE-185. 3 p.

1274. Little, Silas, and Robert T. Escheman.
1976. **Nineteen-year changes in the composition of a stand of** ***Pinus taeda*** **in eastern Maryland.** Torrey Bot. Club Bull. 103(2): 57-66.

1275. Little, Silas, Jack McCormick, and John W. Andresen.
1970. **A selected and annotated bibliography of pitch pine (*Pinus rigida* Mill.).** USDA For. Serv. Res. Pap. NE-164. 103 p.

1276. Little, Silas, and François Mergen.
1966. **External and internal changes associated with basal-crook formation in pitch and shortleaf pines.** For. Sci. 12:268-275.

1277. Little, Silas, John J. Mohr, and Paul V. Mook.
1968. **Ten-year effects from row thinnings in loblolly pine plantations of eastern Maryland.** USDA For. Serv. Res. Note NE-77. 8 p.

1278. Little, Silas, and Horace A. Somes.
1967. **Results of herbicide trials to control Japanese honeysuckle.** USDA For. Serv. Res. Note NE-62. 8 p.

1279. Little, Silas, and Horace A. Somes.
1968. **Herbicide treatments of Japanese honeysuckle for releasing desirable reproduction or for site preparation.** USDA For Serv. Res. Note NE-83. 8 p.

1280. Lloyd, R. Duane.
1976. **A critique of the paper entitled "Wilderness in the East: Problems for research."** *In* Proc. South. States Recreation Res. Appl. Workshop. USDA For. Serv. Gen. Tech. Rep. SE-9. p. 58-60.

1281. Lohr, C. J., Bruce G. Hansen, and Jean W. Nolley.
1971. **Primary wood industries of Kentucky 1971: A utilization summary and directory.** Ky. Dep. Nat. Resour. Div. For. 68 p.

1282. Long, A. J., H. D. Gerhold, and M. E. Demeritt, Jr.
1973. **Metropolitan tree planters survey: Initial results.** Pa. State Univ. Sch. For. Resour. Res. Pap. 41. 14 p.

1283. Longhouse, A. D., and K. C. Elliott. 1966. **Research in power sources as preliminary to new concepts of wood tools.** *In* Forest engineering symp. proc. W. Va. Univ. Bull. 82 p. 104-113.

1284. Lowe, R. E., R. L. Giese, and M. L. McManus.
1967. **Mycetangia of the ambrosia beetle *Monarthrum fasciatum* (Coleoptera: Scolytidae).** J. Invertebr. Pathol. 9:451-458.

1285. Lucas, Edwin L.
1969. **An approach to yellow-poplar tree valuation.** USDA For. Serv. Res. Pap. NE-137. 13 p.

1286. Lucas, Edwin L.
1973. **Long length cuttings from No. 2 Common hardwood lumber.** USDA For. Serv. Res. Pap. NE-248. 5 p.

1287. Lucas, Edwin L., and Philip A. Araman.
1975. **Manufacturing interior furniture parts: A new look at an old problem.** USDA For. Serv. Res. Pap. NE-334. 6 p.

1288. Lucas, Edwin L., and Leathern R. R. Catron.
1973. **A comprehensive defect data bank for No. 2 Common oak lumber.** USDA For. Serv. Res. Pap. NE-262. 8 p.

1289. Lucas, Edwin L., and Charles J. Gatchell.
1976. **STUB: A manufacturing system for producing rough dimension cuttings from low-grade lumber.** USDA For. Serv. Res. Note NE-222. 5 p.

1290. Lucas, John T.
1967. **Wooden pallet requirements by Department of Defense.** South. Lumberman 214(2665):13-16.

1291. Lucas, John T.
1969. **Use of wooden pallets in the brewing industry.** USDA For. Serv. Res. Pap. NE-132. 17 p.

1292. Lucas, John T., and Walter B. Wallin.
1968. **The Department of Defense market for wooden pallets: 1965.** USDA For. Serv. Res. Pap. NE-117. 42 p.

1293. Lucas, John T., and Walter B. Wallin.
1969. **The Department of Defense market for wooden pallets: 1966.** USDA For. Serv. Res. Pap. NE-122. 19 p.

1294. Lucas, John T., and Walter B. Wallin.
1969. **The Department of Defense market for wooden pallets: 1967.** USDA For. Serv. Res. Pap. NE-131. 20 p.

1295. Lucas, Robert C.
1971. **Hikers and other trail users.** *In* Recreation symp. proc. USDA For. Serv. Northeast. For. Exp. Stn. p. 113-122.

1296. Lull, Howard W.
1966. **An annotated bibliography of watershed management research by the Northeastern Forest Experiment Station. 1931—65.** USDA For. Serv. Res. Pap. NE-48. 36 p.

1297. Lull, Howard W.
1967. **Factors influencing water production from forested watersheds.** Munic. Watershed Manage. Symp. Proc. 1965. Univ. Mass. Coop. Ext. Serv. Publ. 446. p. 2-7.

1298. Lull, Howard W.
1967. **How our cities meet their water needs.** *In* Outdoors USA. U.S. Dep. Agric. Yearb. 1967. p. 104-109.

1299. Lull, Howard W.
1968. **A forest atlas of the Northeast.** USDA For. Serv. Northeast. For. Exp. Stn. 46 p.

1300. Lull, Howard W.
1969. **Hydrologic effects from urbanization of forested watersheds in the Northeast.** Soc. Am. For. Annu. Meet. (1968) Abstr. Pap. p. 25-26.

1301. Lull. Howard W.
1969. **Review of "Christians and the good earth."** J. Soil & Water Conserv. 24:198-199.

1302. Lull, Howard W.
1970. **Even-age management on the Monongahela National Forest.** USDA For. Serv. The Chief's Special Review Committee. 44 p.

1303. Lull, Howard W.
1970. **Management possibilities for**

water-yield increases. *In* Joint FAO/USSR International symp. on forest influences and watershed management proc. WM/A 1788. 16 p.

1304. Lull, Howard W.
1971. **Effects of trees and forests on water relations.** *In* Trees and forests in an urbanizing environment. Univ. Mass. Coop. Ext. Serv. Plann. Resour. Dev. Ser. 17:65-69.

1304a. Lull, Howard W.
1971. **Runoff from forest lands.** *In* Man's impact on terrestrial and oceanic ecosystems. W. H. Matthews, F. F. Smith, and E. D. Goldberg, eds. M.I.T. Press, Cambridge, Mass. p. 240-251.

1305. Lull, Howard W.
1972. **Management possibilities for water yield increases.** Joint FAO-USSR Int. Symp. on For. Influences and Watershed Manage. Proc. p. 168-178.

1306. Lull, Howard W., and Henry W. Anderson.
1967. **Important watershed characteristics affecting water yield, flood peaks, and erosion and sedimentation and the basic data needed for prediction.** Int. Conf. Water for Peace Proc. p. 1-8.

1307. Lull, Howard W., and Irvin C. Reigner.
1967. **Radiation measurements by various instruments in the open and in the forest.** USDA For. Serv. Res. Pap. NE-84. 21 p.

1308. Lull, Howard W., and Kenneth G. Reinhart.
1966. **Implications of even-aged management on water.** *In* Trends from selection cutting to even-aged management. Proc. Annu. Winter Meet. Allegheny Sect. Soc. Am. For. p. 54-61.

1309. Lull, Howard W., and Kenneth G. Reinhart.
1967. **Increasing water yield in the Northeast by management of forested watersheds.** USDA For. Serv. Res. Pap. NE-66. 45 p.

1310. Lull, Howard W., and Kenneth G. Reinhart.
1972. **Forests and floods in the Eastern United States.** USDA For. Serv. Res. Pap. NE-226. 94 p.

1311. Lull, Howard W., and William E. Sopper.
1966. **Factors that influence streamflow in the Northeast.** Am. Geophys. Union Water Resour. Res. 2:371-379.

1312. Lull, Howard W., and William E. Sopper.
1966. **How harvesting forest products affects water yield in Appalachia.** *In* Forest resource decisions in a changing power structure. Proc. Soc. Am. For. 1965. p. 108-112.

1313. Lull, Howard W., and William E. Sopper.
1967. **Prediction of average annual and seasonal streamflow of physiographic units in the Northeast.** *In* International symp. on forest hydrology proc. Pergamon Press, Oxford, England. p. 507-522.

1314. Lull, Howard W., and William E. Sopper.
1969. **Hydrologic effects from urbanization of forested watersheds in the Northeast.** USDA For. Serv. Res. Pap. NE-146. 31 p.

1315. Lynch, J. A., E. S. Corbett, and R. J. Hutnik.
1975. **Water resources.** *In* Clearcutting in Pennsylvania. Pa. State Univ. Coll. Agric. Sch. For. Resour. p. 51-64.

1316. Lynch, James A., William E. Sopper, and Edward S. Corbett.
1975. **Watershed behavior under controlled simulated rainfall.** Pa. State Univ. Inst. Res. Land Water Resour. 71 p.

1317. Lynch, James A., W. E. Sopper, E. S. Corbett, and D. W. Aurand.
1975. **Effects of management practices on water quality and quantity: The Penn State experimental watersheds.** *In* Municipal watershed management symp. proc. USDA For. Serv. Gen. Tech. Rep. NE-13. p. 32-46.

1318. MacCollom, G. B., and H. W. Yawney.
1967. **Destruction of sugar maple**

seeds by the anthomyiid *Hylemya florilega*. J. Econ. Entomol. 60:296-297.

1319. MacConnell, William P.
1975. **Remote sensing 20 years of change in Franklin County, Massachusetts, 1952-1972.** Mass. Agric. Exp. Stn. Res. Bull. 626. 103 p.

1320. MacConnell, William P.
1975. **Remote sensing 20 years of change in Hampshire County, Massachusetts, 1952-1972.** Mass. Agric. Exp. Stn. Res. Bull. 627. 91 p.

1321. MacConnell, William P.
1975. **Remote sensing 20 years of change in Hampden County, Massachusetts, 1952-1972.** Mass. Agric. Exp. Stn. Res. Bull. 628. 99 p.

1322. MacConnell, William P.
1975. **Remote sensing 20 years of change in Massachusetts, 1951-1952, 1971-1972.** Mass. Agric. Exp. Stn. Res. Bull. 630. 79 p.

1323. MacConnell, William P., and Marcia Cobb.
1974. **Remote sensing 20 years of change in Middlesex County, Massachusetts, 1951-1971.** Mass. Agric. Exp. Stn. Res. Bull. 622. 159 p.

1324. MacConnell, William P., W. Cunningham, and R. Blanchard.
1974. **Remote sensing 20 years of change in Essex County, Massachusetts, 1951-1971.** Univ. Mass. Coop. Ext. Serv. Publ. 98. 104 p.

1325. MacConnell, William P., and William Niedzwiedz.
1974. **Remote sensing 20 years of change in Worcester County, Massachusetts, 1951-1971.** Mass. Agric. Exp. Stn. Res. Bull. 625. 173 p.

1326. MacConnell, William P., Nancy Arny Pywell, Dana Robertson, and William Niedzwiedz.
1974. **Remote sensing 20 years of change in Barnstable, Dukes, and Nantucket Counties, Massachusetts, 1951-1971.** Mass. Agric. Exp. Stn. Res. Bull. 623. 112 p.

1327. MacConnell, William P., H. Ross Pywell, and Peter E. Young.
1974. **Remote sensing 20 years of change in Suffolk and Norfolk Counties, Massachusetts, 1951-1971.** Mass. Agric. Exp. Stn. Res. Bull. 624. 112 p.

1328. McCauley, Orris D., and David A. Marquis.
1972. **Investment in precommercial thinning of northern hardwoods.** USDA For. Serv. Res. Pap. NE-245. 12 p.

1329. McCauley, Orris D., and Joseph J. Mendel.
1969. **Adjusting quality index log values to represent local and regional commercial sawlog product values.** USDA For. Serv. Res. Pap. NE-149. 28 p.

1330. McCauley, Orris D., and John C. Redman.
1970. **Lumber specifications of the wood-using industries in Kentucky and surrounding states.** Univ. Ky. Agric. Econ. Ext. Inf. Ser. 4. 10 p.

1331. McCauley, Orris D., and George R. Trimble, Jr.
1972. **Forestry returns evaluated for uneven-aged management in two Appalachian woodlots.** USDA For. Serv. Res. Pap. NE-244. 12 p.

1332. McCauley, Orris D., and George R. Trimble, Jr.
1975. **Site quality in Appalachian hardwoods: The biological and economic response under selection silviculture.** USDA For. Serv. Res. Pap. NE-312. 22 p.

1333. McCauley, Orris D., and James C. Whittaker.
1967. **Sawmill practices and problems in the Appalachian hill country of Ohio and Kentucky.** USDA For. Serv. Res. Pap. NE-80. 15 p.

1334. McCauley, Orris D., and James C. Whittaker.
1967. **The value added by sawmilling in the Appalachian hill country of Ohio and Kentucky.** USDA For. Serv. Res. Note NE-67. 4 p.

1335. McCauley, Orris D., and David P. Worley.
1969. **An economic evaluation of**

precommercial thinning in predominantly paper birch stands. *In* Birch symp. proc. USDA For. Serv. Northeast. For. Exp. Stn. p. 128-134.

1336. McCay, Roger E.
1969. **Distributing value gain from three growth factors for yellow-poplar.** USDA For. Serv. Res. Note NE-104. 8 p.

1337. McCay, Roger E.
1975. **Trail-user conflict.** 3rd Natl. Trails Symp. p. 168-171.

1338. McCay, Roger E.
1976. **Ohio trail users.** USDA For. Serv. Res. Note NE-228. 3 p.

1339. McCay, Roger E., and Paul S. DeBald.
1973. **A probability approach to sawtimber tree-value projections.** USDA For. Serv. Res. Pap. NE-254. 9 p.

1340. McCay, Roger E., and George H. Moeller.
1976. **Compatibility of Ohio trail users.** USDA For. Serv. Res. Note NE-225. 4 p.

1341. McCay, Roger, and George Moeller.
1976. **Trail talk.** Woodlands 14(1):8-9.

1342. McCay, Roger E., and William B. White.
1973. **Economic analysis of the gypsy moth problem in the Northeast. I. Applied to commercial forest stands.** USDA For. Serv. Res. Pap. NE-275. 9 p.

1343. McConkey, Thomas W., and Charles E. Swett.
1967. **Light-weight extension tubes for compressed-air garden sprayers.** USDA For. Serv. Res. Note NE-73. 8 p.

1344. McCurdy, Dwight R., and Herbert Echelberger.
1968. **The hunting lease in Illinois.** J. For. 66:124-127.

1345. McDonald, Clark E.
1969. **Birch veneer and plywood demand: Projected needs of the industry.** *In* Birch symp. proc. USDA For. Serv. Northeast. For. Exp. Stn. p. 15-25.

1346. McElwee, R. L.
1970. **Artificial regeneration of hardwoods.** *In* The silviculture of oaks and associated species. USDA For. Serv. Res. Pap. NE-144. p. 17-25.

1347. McGee, Charles E., and F. Bryan Clark.
1975. **Harvesting and reproducing yellow-poplar.** Proc. 3rd Annu. Hardwood Symp. Hardwood Res. Counc. p. 26-31.

1348. McGinnes, E. A., Jr.
1968. **Extent of shake in black walnut.** For. Prod. J. 18(5):80-82.

1349. McGinnes, E. A., Jr., C. Chang, and K. Y-t Wu.
1971. **Ring shake in some hardwood species: The individual tree approach.** J. Polymer Sci., Part C, No. 36. p. 153-176.

1350. McGinnes, E. A., Jr., J. E. Phelps, and J. C. Ward.
1974. **Ultra-structure observations of tangential shake formations in hardwoods.** Wood Sci. 6:206-211.

1351. McGinnes, E. A., Jr., and A. L. Shigo.
1974. **An aid for detection of discoloration and decay in standing trees.** For. Prod. Res. Soc. 28th Annu. Meet. Abstr.: 4.

1352. McGinnes, E. A., Jr., and A. L. Shigo.
1975. **Electronic technique for detecting discoloration, decay, and injury-associated ring shake in black walnut.** For. Prod. J. 25(5):30-32.

1353. McGinnes, E. A., Jr., and K. Y-t Wu.
1973. **Intra-incremental chemical studies of ring shake in scarlet oak.** Wood Sci. 5:287-294.

1354. McIntyre, Thomas.
1976. **Gypsy moth research development, and applications program: structure objectives, and direction.** *In* Proc. of the eighth annual northeastern forest insect work conference. USDA For. Serv. Gen. Tech. Rep. NE-27. p. 15-17.

1355. McManus, Michael L.
1972. **Aerobiology and airborne insects.** Univ. Mich. US/IBP Aerobiol. Program Handb. 2:76-77.

1356. McManus, Michael L.
1972. **A dispersal model for larvae of the gypsy moth,** *Porthetria dispar* **L.** Univ. Mich. US/IBP Aerobiol. Program Handb. 3:16.1-16.16.

1357. McManus, Michael L.
1973. **The role of behavior in the dispersal of newly hatched gypsy moth larvae.** USDA For. Serv. Res. Pap. NE-267. 10 p.

1358. McManus, M. L., and R. L. Giese.
1967. **The Columbian timber beetle,** *Corthylus columbianus* **(Coleoptera: Scolytidae). VI. Description of damage in Sycamore.** J. Econ. Entomol. 60:410-412.

1359. McManus, M. L., and R. L. Giese.
1968. **The Columbian timber beetle,** *Corthylus columbianus.* **VII. The effect of climatic integrants on historic density fluctuations.** For. Sci. 14:242-253.

1360. McManus, M. L., and Harvey R. Smith.
1972. **Importance of the silk trails in the diel behavior of late instars of the gypsy moth.** Environ. Entomol. 1:793-795.

1361. McQuilkin, William E.
1966. **Reclamation for aesthetics.** Pa. State Univ. Coal Mine Spoil Reclam. Proc. 1965. p. 97-105.

1362. McQuilkin, W. E.
1967. **Comment on Schramm's studies of plant colonization on black anthracite mine wastes in Pennsylvania.** Pa. For. 57(1):16-17.

1363. McQuilkin, W. E.
1967. **Status of direct seeding in the Northeast.** USDA For. Serv. Northeast. Area, State and Priv. For. Direct Seeding Workshop Summ. Univ. Mass., Amherst. p. 1.

1364. McQuilkin, William E.
1969. **Thirty years of Federal forest research in the Anthracite Region.** Pa. For. 59:58-62.

1365. McQuilkin, William E.
1970. **To regenerate eastern hardwoods—clearcut.** Am. For. 76(6):20-23,48-49.

1366. McQuilkin, William E., and Eugene F. McNamara.
1967. **Tree planting in scrub oak areas after site preparation with heavy equipment.** USDA For. Serv. Res. Pap. NE-60. 26 p.

1367. McWain, Percy, and Garold F. Gregory.
1971. **Solubilization of benomyl for xylem injection in vascular wilt disease control.** USDA For. Serv. Res. Pap. NE-234. 6 p.

1368. McWain P., and G. F. Gregory.
1972. **A neutral mannan from** *Ceratocystis fagacearum* **culture filtrate.** Phytochemistry 11:2609-2612.

1369. McWain, Percy, and Garold F. Gregory.
1973. **A benomyl-derived fungitoxicant for tree wilt disease control.** USDA For. Serv. Res. Note NE-162. 3 p.

1370. Mader, Donald L.
1973. **Fertilizer needs and treatment responses for wood fiber production: field assessment.** *In* Forest fertilization symp. proc. USDA For. Serv. Gen. Tech. Rep. NE-3. p. 140-154.

1371. Mader, Donald L., and Howard W. Lull.
1968. **Depth, weight, and water storage of the forest floor in white pine stands in Massachusetts.** USDA For. Serv. Res. Pap. NE-109. 35 p.

1372. Manthy, Robert S.
1966. **Economic-base projections for river-basin planners.** *In* Forest resource decisions in a changing power structure. Proc. Soc. Am. For. 1965. p. 94-97.

1373. Manthy, Robert S.
1966. **A forest economist's view of pulpwood marketing systems.** Am. Pulpwood Assoc. Tech. Pap., January. p. 5, 6, 8.

1374. Manthy, R. S.
1967. **Dynamic concepts of timber requirements and availability.** South. Indiana For. Manage. Conf. Proc. 7. p. 38-46.

1375. Manthy, Robert S.
1970. **An investment guide for**

cooperative forest management in Pennsylvania. USDA For. Serv. Res. Pap. NE-156. 59 p.

1376. Manthy, R. S., W. A. Lemmien, V. J. Rudolph, and L. M. James.
1967. **A time study for plantation logging.** Mich. State Univ. Agric. Exp. Stn. Q. Bull. 49(3):328-341.

1377. Marburger, R. G., R. M. Robinson, Jack Ward Thomas, and K. A. Clark.
1970. **Management implications of disease of big game animals in Texas.** Southeast. Assoc. Game and Fish Comm. 24th Annu. Conf. Proc. p. 46-50.

1378. Marquis, David A.
1966. **Germination and growth of paper birch and yellow birch in simulated strip cuttings.** USDA For. Serv. Res. Pap. NE-54. 19 p.

1379. Marquis, David A.
1967. **Clearcutting in northern hardwoods: Results after 30 years.** USDA For. Serv. Res. Pap. NE-85. 13 p.

1380. Marquis, David A.
1967. **Soil moisture-soil temperature interrelationships on a sandy-loam soil exposed to full sunlight.** USDA For. Serv. Res. Note NE-64. 5 p.

1381. Marquis, David A.
1968. **Changing concepts in hardwood management.** Ky. Governor's Conf. on For. Proc. 5. p. 23-41.

1382. Marquis, David A.
1969. **Silvical requirements for natural birch regeneration.** *In* Birch symp. proc. USDA For. Serv. Northeast. For. Exp. Stn. p. 40-49.

1383. Marquis, David A.
1969. **Thinning in young northern hardwoods: 5-year results.** USDA For. Serv. Res. Pap. NE-139. 22 p.

384. Marquis, David A.
1972. **Effect of forest clearcutting on ecological balances.** *In* A perspective on clearcutting in a changing world. Proc. Winter Meet. N.Y. Sect. Soc. Am. For. SUNY Coll. For., Syracuse. AFRI Misc. Rep. 4, p. 47-59.

1385. Marquis, David A.
1973. **Cherry-maple.** *In* Silvicultural systems for the major forest types of the United States. U.S. Dep. Agric., Agric. Handb. 445. p. 78-80.

1386. Marquis, David A.
1973. **Factors affecting financial returns from hardwood tree improvement.** J. For. 71:79-83.

1387. Marquis, David A.
1973. **Pennsylvania's Allegheny hardwood forests.** Pa. For. 63:88-89,108-112.

1388. Marquis, David A.
1974. **The impact of deer browsing on Allegheny hardwood regeneration.** USDA For. Serv. Res. Pap. NE-308. 8 p.

1389. Marquis, David A.
1975. **The Allegheny hardwood forests of Pennsylvania.** USDA For. Serv. Gen. Tech. Rep. NE-15. 32 p.

1390. Marquis, David A.
1975. **Seed storage and germination under northern hardwood forests.** Can. J. For. Res. 5:478-484.

1391. Marquis, David A.
1976. **Silviculture of eastern hardwoods.** *In* The scientific base for silviculture and management decisions in the National Forest System: Selected papers. U.S. Dep. Agric. For. Serv., Washington, D.C. p. 29-38.

1392. Marquis, David A., and Thomas W. Beers.
1969. **A further definition of some forest growth components.** J. For. 67:493.

1393. Marquis, David A., Philip L. Eckert, and Benjamin A. Roach.
1976. **Acorn weevils, rodents, and deer all contribute to oak-regeneration difficulties in Pennsylvania.** USDA For. Serv. Res. Pap. NE-356. 5 p.

1394. Marquis, David A., Ted J. Grisez, John C. Bjorkbom, and Benjamin A. Roach.
1975. **Interim guides to the regeneration of Allegheny hardwoods.** USDA For. Serv. Gen. Tech. Rep. NE-19. 14 p.

1395. Marquis, David A., Dale S. Solomon, and John C. Bjorkbom.
1969. **A silvicultural guide for paper birch in the Northeast.** USDA For. Serv. Res. Pap. NE-130. 47 p.

1396. Marquis, R. W.
1966. **Wood supply: Current and potential.** Tech. Pap. Am. Pulpwood Assoc. April 1966. p. 6,8-10.

1397. Martell, Arthur M.
1974. **Canada yew.** *In* Shrubs and vines for northeastern wildlife. USDA For. Serv. Gen. Tech. Rep. NE-9. p. 158-160.

1398. Martens, David G.
1967. **How lumber price changes affect sawlog values.** USDA For. Serv. Res. Pap. NE-89. 38 p.

1399. Martens, David G.
1968. **Flooring costs: A comparison of installation and maintenance costs for three types of residential flooring.** USDA For. Serv. Res. Pap. NE-124. 23 p.

1400. Martens, David G.
1969. **Flooring costs: A comparison of installation and maintenance cost for three types of residential flooring.** Flooring, January. p. 67-74.

1401. Martens, David G.
1971. Hardwood? Carpet? Tile? USDA For. Serv. Res. Pap. NE-200. 25 p.

1402. Martens, David G., and E. Paul Craft.
1967. **The marcraft floor-leveling system for urban rehabilitation.** USDA For. Serv. Res. Note NE-66. 8 p.

1403. Martens, David G., and Neil K. Huyler.
1970. **Length and width distribution of 4/4 Appalachian hard maple lumber.** South. Lumberman 221(2751):19-20.

1404. Martens, David G., and Leonard J. Koenick.
1970. **Use of hardwood flooring in mobile homes.** USDA For. Serv. Res. Pap. NE-172. 10 p.

1405. Martin, A. Jeff.
1971. MULGRES: A computer **program for stepwise multiple regression analysis.** USDA For. Serv. Res. Note NE-128. 5 p.

1406. Martin, A. Jeff.
[1971] **MULGRES user's manual.** USDA For. Serv. Northeast. For. Exp. Stn. 137 p.

1407. Martin, A. Jeff.
1971. **The relative importance of factors that determine log-hauling costs.** USDA For. Serv. Res. Pap. NE-197. 15 p.

1408. Martin, A. Jeff.
1972. **The aggressive skidder operator and his impact on logging costs.** South. Lumberman 225(2800):129.

1409. Martin, A. Jeff.
1973. **Computer simulation as a low-cost approach to logging system balance.** For. Ind. 100(9):52-54.

1410. Martin, A. Jeff.
1975. **A first look at logging residue characteristics in West Virginia.** USDA For. Serv. Res. Note NE-200. 3 p.

1411. Martin, A. Jeff.
1975. **Predicting logging residues: An interim equation for Appalachian oak sawtimber.** USDA For. Serv. Res. Note NE-203. 4 p.

1412. Martin, A. Jeff.
1975. **REST: A computer system for estimating logging residue by using the line-intersect method.** USDA For. Serv. Res. Note NE-212. 4 p.

1413. Martin, A. Jeff.
1975. **T-H-A-T-S: Timber harvesting and transport simulator.** USDA For. Serv. Res. Pap. NE-316. 31 p.

1414. Martin, A. Jeff.
1976. **A logging residue "yield" table for Appalachian hardwoods.** USDA For. Serv. Res. Note NE-227. 3 p.

1415. Martin, A. Jeff.
1976. **Suitability of the line-intersect method for sampling hardwood logging residues.** USDA For. Serv. Res. Pap. NE-339. 6 p.

1416. Martin, A. Jeff, and Victor J. Rudolph.
1975. **Evaluating northern hardwood timber stand improvement opportunities in northern lower**

Michigan. Mich. State Univ. Agric. Exp. Stn. Res. Rep. 267. 10 p.

1417. Martin, A. Jeff, and Paul E. Sendak.
1973. **Operations research in forestry: A bibliography.** USDA For. Serv. Gen. Tech. Rep. NE-8. 90 p.

1418. Martin, C. Wayne, and James W. Hornbeck.
1972. **Lysimeter snowmelt and streamflow on forested and cleared sites.** East. Snow Conf. Proc. 29:111-118.

1419. Marton, Renata, G. R. Stairs, and E. J. Schreiner.
1968. **Influence of growth rate and clonal effects on wood anatomy and pulping properties of hybrid poplars.** TAPPI 51:230-235.

1420. Marty, Robert.
1966. **Economic guides for blister-rust control in the East.** USDA For. Serv. Res. Pap. NE-45. 14 p.

1421. Marty, Robert J.
1966. **How much can you afford to spend controlling forest insects?** La. State Univ. For. Proc. p. 38-50.

1422. Marty, Robert, Charles Rindt, and John Fedkiw.
1966. **A guide for evaluating reforestation and stand improvement projects in timber management planning on the National Forests.** U.S. Dep. Agric., Agric. Handb. 304. 24 p.

1423. Marty, Robert, and George R. Trimble, Jr.
1967. **Planning for timber tract development.** USDA For. Serv. Res. Pap. NE-64. 15 p.

1424. Marvin, David R.
1973. **Maple syrup & the blends.** Natl. Maple Syrup Dig. 12(3):12-15.

1425. Marx, Hal.
1971. **X-rays for trees.** For. Farmer 31(1):9,18.

1426. Massey, H. F.
1972. **pH and soluble Cu, Ni and Zn in eastern Kentucky coal mine spoil materials.** Soil Sci. 114:217-221.

1427. Massey, H. F., and R. I. Barnhisel.
1972. **Copper, nickel, and zinc released from acid coal mine spoil materials of eastern Kentucky.** Soil Sci. 113:207-212.

1428. Mawson, Joseph C., Jack Ward Thomas, and Richard M. DeGraaf.
1976. **Program HTVOL: The determination of tree crown volume by layers.** USDA For. Serv. Res. Pap. NE-354. 9 p.

1429. May, Robert F., and William A. Berg.
1966. **Overburden and bank acidity: Eastern Kentucky strip mines.** Coal Age 71(6): 74-75.

1430. May, Robert F., and W. David Striffler.
1967. **Watershed aspects of stabilization and restoration of strip-mined areas.** *In* International symp. on forest hydrology proc. Pergamon Press, Oxford, England. p. 663-671.

1431. Mazur, A. R., T. D. Hughes, and J. B. Gartner.
1975. **Physical properties of hardwood bark growth media.** HortScience 19(1):30-33.

1432. Mazzone, H. M.
1967. **Equilibrium centrifugation.** *In* Methods in virology. Academic Press, New York. p. 41-91.

1433. Mazzone, H M.
1968. **Utilization of hemolymph in insect tissue culture.** Int. Colloq. Invertebr. Tissue Culture. p. 14-21.

1434. Mazzone, H. M.
1971. **Cultivation of gypsy moth hemocytes.** Curr. Top. Microbiol. Immunol. 55:196-200.

1435. Mazzone, H. M.
1975. **An analysis of serological studies on the nucleopolyhedrosis and granulosis (capsule) viruses of insects.** *In* Baculoviruses for insect pest control: Safety considerations, M. Summers, ed. Am. Soc. Microbiol. p. 33-38.

1436. Mazzone, H. M., J. P. Breillatt, and N. G. Anderson.
1971. **Zonal rotor purification and properties of a nuclear polyhedrosis virus of the European pine sawfly.** 4th Int. Colloq. Insect Pathol. p. 371-379.

1437. Mazzone, H. M., G. H. Tignor, R. E. Shope, I. C. Pan, and W. R. Hess.
1976. **A serological comparison of the nuclear polyhedrosis viruses of the gypsy moth and the European pine sawfly with arthropod-borne and other viruses.** Environ. Entomol. 5:281-282.

1438. Meadows, John C., Jr., and Albert T. Schuler.
1976. **Nonlinear programming and the decreasing marginal utility problem: A goal programming framework for decision.** Annu. Meet. Southeast. Chapter Inst. Manage. Sci. Proc. 12. p. 307-314.

1439. Meehan, W. R., W. A. Farr, D. M. Bishop, and J. H. Patric.
1969. **Some effects of clearcutting on salmon habitat of two southeast Alaska streams.** USDA For. Serv. Res. Pap. PNW-82. 45 p.

1440. Melhuish, J. H., Jr., and E. Hacskaylo.
1975. **Fatty acid composition of ectomycorrhizal fungi in vitro.** Mycologia 67:952-960.

1441. Mendel, Joseph J.
1967. **Forestry accomplishments in southeastern Ohio under the U.S. Agricultural Conservation Program, 1957-64.** USDA For. Serv. Res. Pap. NE-65. 26 p.

1442. Mendel, Joseph J.
1969. **Financial maturity of paper birch.** *In* Birch symp. proc. USDA For. Serv. Northeast. For. Exp. Stn. p. 135-144.

1443. Mendel, J. J., P. S. DeBald, and M. E. Dale.
1976. **Tree value conversion standards for hardwood sawtimber.** SETs: Stand Evaluation Tools. 2. USDA For. Serv. Res. Pap. NE-337. 74 p.

1444. Mendel, Joseph J., Ted J. Grisez, and G. R. Trimble, Jr.
1973. **The rate of value increase for sugar maple.** USDA For. Serv. Res. Pap. NE-250. 19 p.

1445. Mendel, Joseph J., and William H. Smith.
1970. **Quality index tables for some eastern hardwood species.** USDA For. Serv. Res. Pap. NE-167. 24 p.

1446. Mendel, Joseph J., and George R. Trimble, Jr.
1969. **The rate of value increase for yellow-poplar and beech.** USDA For. Serv. Res. Pap. NE-140. 27 p.

1447. Michalski, L.
1976. **Effects of ionizing radiation on changes in the level of gibberellin-like substances during Scotch pine seed germination.** Acta Soc. Bot. Pol. 45:263-269.

1448. Michalski, Leszek.
1974. **Content of plant growth regulators in the developing seeds of oak (*Quercus robur* L.). III. Kinetin-like substances.** Acta Soc. Bot. Pol. 43:307-312.

1449. Michie, Jarvis D., Charles J. Gatchell, and Theodore J. Duke.
1971. **Dynamic evaluation of timber posts for highway guardrails.** Design of Traffic Safety Barriers, Natl. Acad. Sci. Highway Res. Board, Highway Res. Rec. 343. p. 19-33.

1450. Michniewicz, M., and E. Galoch.
1974. **The role of vanillin and p-coumaric acid in the growth of Scotch pine seedlings.** Acta Soc. Bot. Pol. 43:273-281.

1451. Michniewicz, M., E. Galoch, B. Rozej, and Z. Zatorska.
1974. **Dynamics of endogenous plant growth regulators in the early stages of growth and development of Scotch pine seedlings (*Pinus silvestris* L.).** Pol. Acad. Sci. Ser. Biol. Bull. 22:(9) 625-631.

1452. Michniewicz, M., B. Rozej, and K. Lamparska.
1976. **The role of ferulic acid in the rooting process.** Proc. 4th Symp. Plant Growth Regulators (Toŕun, Poland, 1974). p. 95-101.

1453. Miller, William C.
1971. **Distribution of maple strip flooring in 1969.** USDA For. Serv. Res. Pap. NE-215. 24 p.

1454. Miller, William C.
1971. **Physical distribution of oak strip flooring in 1969.** USDA For. Serv. Res. Pap. NE-207. 31 p.

1455. Miller, William C.
1972. **Distribution of parquet flooring**

during 1969. USDA For. Serv. Res. Pap. NE-218. 11 p.

1456. Millers, I., and W. E. Wallner.
1975. **The redhumped oakworm**. U.S. Dep. Agric. For. Pest Leafl. 153. 6 p.

1457. Minckler, Leon S., and Samuel F. Gingrich.
1970. **Relation of crown width to tree diameter in some upland hardwood stands of southern Illinois**. USDA For. Serv. Res. Note NC-99. 4 p.

1458. Moeller, George H.
1969. **The snowmobile: Boondocks bonanza or bust?** North. Logger 18(5):24,43,45.

1459. Moeller, George H.
1971. **Growth of the camping market in the Northeast**. USDA For. Serv. Res. Pap. NE-202. 21 p.

1460. Moeller, George H.
1971. **The landowner and the snowmobiler: Problem or profit?** USDA For. Serv. Res. Pap. NE-206. 15 p.

1461. Moeller, George H.
1975. **The Delphi technique: An approach to identifying events that will shape the future of outdoor recreation.** *In* indicators of change in the recreational environment: A national research symposium. Pa. State Univ. HPER Ser. 6. 211-220.

1462. Moeller, George H.
[1976] **Future trends in recreation resources management.** *In* Environmental attitudes, ethics, values and their communication. 21st Natl. Conserv. Educ. Assoc. Conf. Proc. p. 20-21.

1463. Moeller, G. H., and H. E. Echelberger.
1974. **Approaches to forecasting recreation consumption.** *In* Outdoor recreation research: Applying the results. USDA For. Serv. Gen. Tech. Rep. NC-9. p. 43-55.

1464. Moeller, George H., and John H. Engelken.
1972. **What fishermen look for in a fishing experience**. J. Wildl. Manage. 36:1253-1257.

1465. Moeller, George H., and John Engelken.
1973. **Fishermen expectations and pay-lake profits.** USDA For. Serv. Res. Pap. NE-264. 5 p.

1466. Moeller, G. H., and J. H. Engelken.
1974. **What fishermen look for in a fishing experience.** Trout 5(4):28,43-44. [Reprinted from J. Wildl. Manage. 36:1253-1257.]

1467. Moeller, George H., Rodney G. Larson, and Douglas A. Morrison.
1974. **Opinions of campers and boaters at the Allegheny reservoir.** USDA For. Serv. Res. Pap. NE-307. 26 p.

1468. Moeller, George H., Robert MacLachlan, and Douglas A. Morrison.
1974. **Measuring perception of elements in outdoor environments.** USDA For. Serv. Res. Pap. NE-289. 9 p.

1469. Moeller, George H., and Douglas A. Morrison.
1971. **Campground owners: Your business may be influenced by how you answer mail**. SUNY Coll. For. Dep. Resour. Manage., Syracuse. 7 p.

1470. Moeller, George H., Gerald S. Walton, and Elwood L. Shafer, Jr.
1975. **Dimensions of recreation resource planning decisions.** Recreation Rev. 4(2):24-35.

1471. Mook, Paul V.
1966. **Heart rots of balsam fir.** U.S. Dep. Agric. For. Pest Leafl. 100. 6 p.

1472. Moore, Gary S., Normand R. Dubois, and Haim B. Gunner.
1975. **The effect of microbial mycolytic agents on *Trichophyton rubrum*.** Mycopathologia 57:93-98.

1473. More, Thomas A.
1976. **Urban forest recreation: A strategy for research.** *In* Proc. South. States Recreation Res. Appl. Workshop. USDA For. Serv. Gen. Tech. Rep. SE-9. p. 61-68.

1474. Morris, R. F.
1969. **Approaches to the study of population dynamics.** *In* Forest insect population dynamics. USDA For. Serv. Res. Pap. NE-125. p. 9-28.

1475. Morrison, Douglas A., and George H. Moeller.
1971. **Hints in requesting campground information.** SUNY Coll. For. Dep. Resour. Manage., Syracuse. 7 p.

1476. Morrow, Robert R., and Carter B. Gibbs.
1968. **Vacuum pumping doubles maple sap yield on flat land.** USDA For. Serv. Res. Note NE-91. 5 p.

1477. Moser, Harold C.
1971. **Manufacture of oak furniture, cabinets, and panels.** *In* Oak symp. proc. USDA For. Serv. Northeast. For. Exp. Stn. p. 100-102.

1478. Mott, D. G.
1966. **The analysis of determination in population systems.** *In* Systems analysis in ecology. Academic Press, New York, p. 179-194.

1479. Mott, D. G.
1969. **Dynamic models for population systems.** *In* Forest insect population dynamics. USDA For. Serv. Res. Pap. NE-125. p. 53-73.

1480. Mott, D. Gordon.
1969. **Review of "Ecology of insect vector populations."** Science 164:941.

1481. Mott, D. G.
1973. **Future pest management systems.** *In* Pest management for the 21st century: A symposium. Idaho Res. Found. Natl. Rep. Ser. 2. p. 73-92.

1482. [Mount, Peter R.]
1971. **The Appalachian pallet industry.** North. Logger 20(2):22-23, 60-61.

1483. Murphey, Wayne K., and Robert L. Brisbin.
1970. **Influence of sewage plant effluent irrigation on crown wood and stem wood of red pine.** Pa. State Univ. Agric. Exp. Stn. Bull. 772. 30 p.

1484. Murphey, Wayne K., R. L. Brisbin, and A. P. Binotto.
1973. **Tracheid properties of red pine stem and crown wood from trees irrigated with sewage plant effluent.** Pa. State Univ. Agric. Exp. Stn. Bull. 789. 22 p.

1485. Murphey, W. K., B. E. Cutter, E. Wachsmuth, and C. Gatchell.
1971. **Feasibility studies on gluing of red oak at elevated moisture contents.** For. Prod. J. 21(8):56-59.

1486. Myklestad, Erik, and J. Alan Wagar.
1976. **PREVIEW: Computer assistance for visual management of forested landscapes.** USDA For. Serv. Res. Pap. NE-355. 12 p.

1487. Nagle, George S., and Robert S. Manthy.
1966. **The market for fireplace wood in an urban area of Connecticut.** USDA For. Serv. Res. Pap. NE-51. 16 p.

1488. Nathan, K., G. H. Nieswand, E. S. Corbett, and J. R. Pawlow.
1976. **Rainfall-runoff relationship of a small drainage area under suburban development.** ASAE Winter Meet., Chicago, Ill. Pap. No. 76-2542. 25 p.

1489. Neely, Dan.
1975. **Sanitation and Dutch elm disease control.** *In* Dutch elm disease. USDA For. Serv. Northeast. For. Exp. Stn. p. 76-87.

1490. Neely, Robert D., and Robert W. Campbell.
1973. **A system for gathering small-mammal mortality data.** USDA For. Serv. Res. Pap. NE-280. 6 p.

1491. Nelson, James C., Benjamin A. Roach, O. Lynn Frank, and Wilber Ward.
1975. **Timber management.** *In* Clearcutting in Pennsylvania. Pa. State Univ. Coll. Agric. Sch. For. Resour. p. 33-49.

1492. Nelson, Thomas C., and Malcolm J. Williamson.
1970. **Decorative plants of Appalachia: A source of income.** U.S. Dep. Agric., Agric. Inf. Bull. 342. 31 p.

1493. Nelson, William R., Jr.
1976. **Esthetic considerations in the selection and use of trees in the urban environment.** *In* Better trees for metropolitan landscapes symp. proc. USDA

For. Serv. Gen. Tech. Rep. NE-22. p. 13-24.

1494. Nevel, Robert L., Jr.
1973. **Factors affecting the use of hardwood flooring in urban rehabilitation.** USDA For. Serv. Res. Pap. NE-273. 7 p.

1495. Nevel, Robert L., Jr.
1974. **Recommended action for the wood-flooring industry to secure its share of the urban rehabilitation market.** USDA For. Serv. Res. Pap. NE-287. 5 p.

1496. Nevel, Robert L., Jr.
1974. **Use of hardwood flooring in urban rehabilitation.** For. Prod. J. 25(1):13-16.

1497. Newby, Floyd L.
1971. **Understanding the visual resource.** *In* Recreation symp. proc. USDA For. Serv. Northeast. For. Exp. Stn. p. 68-72.

1498. Nieswand, G. H., T. Shelton, T. Fusillo, and E. S. Corbett.
1976. **A study of the impact of suburban development on water quality in a small watershed.** ASAE Winter Meet., Chicago, Ill. Pap. No. 76-2543. 18 p.

1499. Niskala, George R., and Thomas W. Church, Jr.
1966. **Cutting hardwood cants can boost sawmill profits.** USDA For. Serv. Res. Note NE-46. 7 p.

1500. Nixon, Charles M., and D. Michael Worley.
1974. **Partridgeberry.** *In* Shrubs and vines for northeastern wildlife. USDA For. Serv. Gen. Tech. Rep. NE-9. p. 111-112.

1501. Nolley, Jean W.
1969. **Christmas tree marketing: A bibliography**. Am. Christmas Tree J. 13(2):23-26.

1502. Nolley, Jean W.
1970. **Christmas tree marketing: A bibliography**. Am. Christmas Tree J. 14(2):27-31.

1503. Nolley, Jean.
1971. **Christmas tree marketing: A bibliography.** Am. Christmas Tree J. 15(2):25-29.

1504. Nolley, Jean W.
1972. **Christmas tree marketing: A bibliography.** Am. Christmas Tree J. 16(2):23-28.

1505. Nolley, Jean W.
1973. **Christmas tree marketing: A bibliography.** Am. Christmas Tree J. 17(2):13-17.

1506. Nolley, Jean W.
1974. **Christmas trees: A bibliography.** Am. Christmas Tree J. 18(2):21-28.

1507. Nolley, Jean W.
1975. **Christmas trees: A bibliography**. Am. Christmas Tree J. 19(2):21-27.

1508. Nolley, Jean W.
1976. **Christmas trees: A bibliography.** Am. Christmas Tree J. 20(4):25-28. (1976 supplement)

1509. Norcott, Kendall S.
1969. **Birch management on industry lands.** *In* Birch symp. proc. USDA For. Serv. Northeast. For. Exp. Stn. p. 172-175.

1510. Northeastern Forest Experiment Station.
1966. **Report 1965.** USDA For. Serv. Northeast. For. Exp. Stn. 70 p.

1511. Northeastern Forest Experiment Station.
1967. **Report 1966.** USDA For. Serv. Northeast. For. Exp. Stn. 98 p.

1512. Northeastern Forest Experiment Station.
1968. **Report 1967.** USDA For. Serv. Northeast. For. Exp. Stn. 53 p.

1513. Northeastern Forest Experiment Station.
1969. **Bartlett Experimental Forest.** USDA For. Serv. Northeast. For. Exp. Stn. 12 p.

1514. Northeastern Forest Experiment Station.
1969. **Birch symposium proceedings.** USDA For. Serv. Northeast. For. Exp. Stn. 183 p.

1515. Northeastern Forest Experiment Station.
1969. **Black diamonds and green vistas.** USDA For. Serv. Northeast. For. Exp. Stn. 14 p.

1516. Northeastern Forest Experiment Station.
1969. **Buying your Christmas tree.** USDA For. Serv. Northeast. For. Exp. Stn. 24 p.

1517. Northeastern Forest Experiment Station.
1969. **Fernow Experimental Forest.** USDA For. Serv. Northeast. For. Exp. Stn. 12 p.

1518. Northeastern Forest Experiment Station.
1969. **Forest insect population dynamics.** USDA For. Serv. Res. Pap. NE-125. 126 p.

1519. Northeastern Forest Experiment Station.
1969. **Medicinal plants research.** USDA For. Serv. Northeast. For. Exp. Stn. 12 p.

1520. Northeastern Forest Experiment Station.
1969. **People, cities, and trees.** USDA For. Serv. Northeast. For. Exp. Stn. 16 p.

1521. Northeastern Forest Experiment Station.
1969. **Report 1968.** USDA For. Serv. Northeast. For. Exp. Stn. 42 p.

1522. Northeastern Forest Experiment Station.
1969. **So, who needs persistent pesticides?** Am. Christmas Tree J. 13(4):7-9.

1523. Northeastern Forest Experiment Station.
1970. **Man's best friend, the tree.** USDA For. Serv. Northeast. For. Exp. Stn. 6 p.

1524. Northeastern Forest Experiment Station.
1970. **More than trees.** USDA For. Serv. Northeast. For. Exp. Stn. 16 p.

1525. Northeastern Forest Experiment Station.
1970. **1969 at the Northeastern Station.** USDA For. Serv. Northeast. For. Exp. Stn. 42 p.

1526. Northeastern Forest Experiment Station.
1970. **Penobscot Experimental Forest.** USDA For. Serv. Northeast. For. Exp. Stn. 12 p.

1527. Northeastern Forest Experiment Station.
1970. **The silviculture of oaks and associated species.** USDA For. Serv. Res. Pap. NE-144. 66 p.

1528. Northeastern Forest Experiment Station.
1970. **Trees: Nature's way to diminish noise.** Wonderful W. Va. 34(7):10.

1529. Northeastern Forest Experiment Station.
1971. **Gypsy moth eats its way through eleven states.** Trees Mag. 31:79-81.

1530. Northeastern Forest Experiment Station.
1971. **The Mead Corporation experimental forests: Vinton Furnace and Mead.** USDA For. Serv. Northeast. For. Exp. Stn. 12 p.

1531. Northeastern Forest Experiment Station.
1971. **1970 at the Northeastern Station.** USDA For. Serv. Northeast. For. Exp. Stn. 54 p.

1532. Northeastern Forest Experiment Station.
1971. **Oak symposium proceedings.** USDA For. Serv. Northeast. For. Exp. Stn. 161 p.

1533. Northeastern Forest Experiment Station.
1971. **Recreation symposium proceedings.** USDA For. Serv. Northeast. For. Exp. Stn. 211 p.

1534. Northeastern Forest Experiment Station.
1971. **Toward integrated control.** Proc. third annual Northeast forest insect work conference. USDA For. Serv. Res. Pap. NE-194. 129 p.

1535. Northeastern Forest Experiment Station.
1971. **Trees need your help, too.** USDA For. Serv. Northeast. For. Exp. Stn. 8 p.

1536. Northeastern Forest Experiment Station.
1971. **Trees need your help, too.** Outdoor Oklahoma, June 1971. p. 14-15.

1537. Northeastern Forest Experiment Station.
1972. **Bark mulch, natural artistry around your house.** USDA For. Serv. Northeast. For. Exp. Stn. 20 p.

1538. Northeastern Forest Experiment Station.
(1972). **The case of the humming mice.** USDA For. Serv. Northeast. For. Exp. Stn. 4 p.

1539. Northeastern Forest Experiment Station.
1972. **Give trees a 'shot in the bark'.** USDA For. Serv. Northeast. For. Exp. Stn. 4 p.

1540. Northeastern Forest Experiment Station.
1972. **Hubbard Brook Experimental Forest.** USDA For. Serv. Northeast. For. Exp. Stn. 16 p.

1541. Northeastern Forest Experiment Station.
1972. **More than trees.** USDA For. Serv. Northeast. For. Exp. Stn. 16 p.

1542. Northeastern Forest Experiment Station.
1972. **New forest laboratory.** N.H. For. Notes 111:11-13.

1543. Northeastern Forest Experiment Station.
1972. **1971 at the Northeastern Station.** USDA For. Serv. Northeast. For. Exp. Stn. 51 p.

1544. Northeastern Forest Experiment Station.
1972. **Our air: Unfit for trees.** USDA For. Serv. Northeast. For. Exp. Stn. 21 p.

1545. Northeastern Forest Experiment Station.
1972. **Raindrops keep falling.** USDA For. Serv. Northeast. For. Exp. Stn. 6 p.

1546. Northeastern Forest Experiment Station.
[1972] **Scientists learn wild turkey talk and more.** USDA For. Serv. Northeast. For. Exp. Stn. 4 p.

1547. Northeastern Forest Experiment Station.
1972. **Summary of the forest recreation symposium.** USDA For. Serv. Res. Pap. NE-235. 21 p.

1548. Northeastern Forest Experiment Station.
1972. **Trees—helping to clean our air?** USDA For. Serv. Northeast. For. Exp. Stn. 4 p.

1549. Northeastern Forest Experiment Station.
1972. **Working with nature to control the gypsy moth.** USDA For. Serv. Northeast. For. Exp. Stn.

1550. Northeastern Forest Experiment Station.
1973. **Forest fertilization symposium proceedings.** USDA For. Serv. Gen. Tech. Rep. NE-3. 246 p.

1551. Northeastern Forest Experiment Station.
1973. **George D. Aiken Sugar Maple Laboratory.** USDA For. Serv. Northeast. For. Exp. Stn.

1552. Northeastern Forest Experiment Station.
1973. **1972 at the Northeastern Station.** USDA For. Serv. Northeast. For. Exp. Stn. 37 p.

1553. Northeastern Forest Experiment Station.
1973. **A tree hurts, too.** USDA For. Serv. Northeast. For. Exp. Stn. 28 p.

1554. [Northeastern Forest Experiment Station.]
1973. **Trees for polluted air.** U.S. Dep. Agric. Misc. Publ. 1230. 12 p.

1555. Northeastern Forest Experiment Station.
1974. **Cable logging in Appalachia? Forestry researchers look at two systems.** USDA For. Serv. Photo Story No. 28. 4 p.

1556. Northeastern Forest Experiment Station.
1974. **Forestry Sciences Laboratory, Warren, Pennsylvania.** USDA For. Serv. Northeast. For. Exp. Stn. 4 p.

1557. Northeastern Forest Experiment Station.
1974. **To heal the scars.** USDA For. Serv. Northeast. For. Exp. Stn. 16 p.

1558. Northeastern Forest Experiment Station.
1974. **Leisure environments: Now, 2000 and beyond.** USDA For. Serv. Northeast. For. Exp. Stn. 8 p.

1559. Northeastern Forest Experiment Station.
1974. **1973 at the Northeastern Station.** USDA For. Serv. Northeast. For. Exp. Stn. 59 p.

1560. Northeastern Forest Experiment Station.
1974. **Northeastern Forest Experiment Station.** USDA For. Serv. Northeast. For. Exp. Stn. 12 p.

1561. Northeastern Forest Experiment Station.
1974. **Research and demonstration of improved surface mining techniques in eastern Kentucky: Revegetation manual.** Report ARC-71-66-T4, Berea, Ky. USDA For. Serv. Northeast. For. Exp. Stn. 101 p.

1562. Northeastern Forest Experiment Station.
1974. **Trees are . . . [environmental wonder workers].** USDA For. Serv. Northeast. For. Exp. Stn. 6 p.

1563. Northeastern Forest Experiment Station.
1975. **Dutch elm disease.** USDA For. Serv. Northeast. For. Exp. Stn. 94 p.

1564. Northeastern Forest Experiment Station.
[1975] **Green vistas . . . black diamonds.** USDA For. Serv. Northeast. For. Exp. Stn. 7 p.

1565. Northeastern Forest Experiment Station.
[1975] **How to keep your trees healthy.** USDA For. Serv. Northeast. For. Exp. Stn. 1 p.

1566. Northeastern Forest Experiment Station.
[1975] **How to kill your tree.** USDA For. Serv. Northeast. For. Exp. Stn. 1 p.

1567. Northeastern Forest Experiment Station.
[1975] **How to treat wounds to prevent decay.** USDA For. Serv. Northeast. For. Exp. Stn. 1 p.

1568. Northeastern Forest Experiment Station.
1975. **Hubbard Brook: An outdoor forest lab.** N.H. For. Notes 124:20-22.

1569. Northeastern Forest Experiment Station.
1975. **Municipal Watershed Management Symposium Proceedings.** USDA For. Serv. Gen. Tech. Rep. NE-13. 196 p.

1570. Northeastern Forest Experiment Station.
1975. **1974 at the Northeastern Station.** USDA For. Serv. Gen. Tech. Rep. NE-18. 48 p.

1571. Northeastern Forest Experiment Station.
1976. **Better trees for metropolitan landscapes symposium proceedings.** USDA For. Serv. Gen. Tech. Rep. NE-22. 256 p.

1572. Northeastern Forestry Committee.
1976. **Forest and air relationships research priorities in the Northeast.** Northeast. Reg. Plann. Comm. 18 p.

1573. Northeastern Forest Experiment Station.
1976. **How to have healthy trees in parks and campgrounds.** USDA For. Serv. Northeast. For. Exp. Stn. 1 p.

1574. Northeastern Forest Experiment Station.
1976. **How to manage woodlands for birds.** USDA For. Serv. Northeast. For. Exp. Stn. NE-INF-31-76. 8 p.

1575. Northeastern Forest Experiment Station.
1976. **How to prune trees.** USDA For. Serv. Northeast. For. Exp. Stn. 1 p.

1576. Northeastern Forest Experiment Station.
1976. **How to recognize and prevent tree hazards.** USDA For. Serv. Northeast. For. Exp. Stn. 1 p.

1577. Northeastern Forest Experiment Station.
1976. **Ingredients for successful Dutch elm disease control.** USDA For. Serv. Northeast. For. Exp. Stn. NE-INF-29-76. 6 p.

1578. Northeastern Forest Experiment Station.

1976. **1975 at the Northeastern Forest Experiment Station.** USDA For. Serv. Gen. Tech. Rep. NE-24. 39 p.

1579. Northeastern Forest Experiment Station.
1976. **Outdoor recreation participation in northeastern Pennsylvania, 1975.** USDA For. Serv. Northeast. For. Exp. Stn. 8 p.

1580. Northeastern Forest Experiment Station.
1976. **Proceedings of the eighth annual northeastern forest insect work conference.** USDA For. Serv. Gen. Tech. Rep. NE-27. 20 p.

1581. Northeastern Forest Experiment Station.
1976. **Research: Northeastern Forest Experiment Station.** USDA For. Serv. NE-INF-28-76. 12 p.

1582. Northeastern Forest Experiment Station.
1976. **Research: People/places/projects.** USDA For. Serv. Northeast. For. Exp. Stn. 2 p.

1583. Norton, Kenneth, and Harold B. Gatslick.
1969. **Potential of low temperature drying of eastern spruce and eastern hemlock.** For. Prod. J. 19(10):33-36.

1584. Noyes, John H.
1969. **Management of birch for aesthetics and recreation.** *In* Birch symp. proc. USDA For. Serv. Northeast. For. Exp. Stn. p. 178-180.

1585. Noyes, John H., and Donald R. Progulske, eds.
1974. **Wildlife in an urbanizing environment.** Univ. Mass. Holdsworth Nat. Resour. Cent. Plann. Resour. Dev. Ser. 28. 182 p.

1586. Nyland, Ralph D.
1973. **Center of gravity for tree-length hardwood sawlogs.** SUNY Coll. Environ. Sci. For., Syracuse. AFRI Res. Note 9. 2 p.

1587. Nyland, Ralph D.
1973. **Weight scaling for tree-length hardwood sawlogs in New York.** SUNY Coll. Environ. Sci. For., Syracuse. AFRI Res. Rep. 14. 7 p.

1588. Nyland, R. D., P. J. Craul, D. F. Behrend, H. E. Echelberger, W. J. Gabriel, R. L. Nisson, Jr. R. Uebler, and J. Zarnetske.
1976. **Logging and its effects in northern hardwoods.** SUNY Coll. Environ. Sci. For., Syracuse. AFRI Res. Rep. 31. 134 p.

1589. Nyland, Ralph D., H. Jack Irish, and Daniel L. Marlatt.
1972. **Volume related to weight in tree-length hardwoods.** SUNY Coll. Environ. Sci. For., Syracuse. AFRI Res. Note 4. 1 p.

1590. ODell, Thomas.
1976. **An overview of the eighth annual northeastern forest insect work conference.** *In* Proc. eighth annual northeastern forest insect work conference. USDA For. Serv. Gen. Tech. Rep. NE-27. p. 1-2.

1591. ODell, T. M., P. A. Godwin, and W. B. White.
1974. **Radiographing puparia of tachinid parasites of the gypsy moth, and application in parasite-release programs.** USDA For. Serv. Res. Note NE-194. 4 p.

1592. ODell, T. M., and W. D. Rollinson.
1966. **A technique for rearing the gypsy moth *Porthetria dispar* (L.). on an artificial diet.** J. Econ. Entomol. 59:741-742.

1593. ODell, Thomas M., and Ian H. von Lindern.
1976. **A technique for marking first-stage larvae of the gypsy moth for dispersal studies.** USDA For. Serv. Res. Note NE-223. 4 p.

1594. Olson, David F., Jr., and Stephen G. Boyce.
1971. **Factors affecting acorn production and germination and early growth of seedlings and seedling sprouts.** *In* Oak symp proc. USDA For. Serv. Northeast. For. Exp. Stn. p. 44-48.

1595. Olson, David F., Jr., and W. J. Gabriel.
1974. **Acer L.: Maple.** *In* Seeds of woody plants in the United States. U.S. Dep. Agric., Agric. Handb. 450. p. 187-194.

1596. Orr, Howard R.
1971. **Design and layout of recreation facilities.** *In* Recreation symp. proc. USDA For. Serv. Northeast. For. Exp. Stn. p. 23-27.

1597. Ostrander, M. D.
1971. **Identification and evaluation of defects in eastern white pine logs and trees.** USDA For. Serv. Res. Pap. NE-190. 27 p.

1598. Ostrander, M. D.
1974. **Eastern spruce: An American Wood.** U.S. Dep. Agric., For. Serv. Am. Woods Ser. FS-263. 10 p.

1599. Ostrander, Myron D.
1968. **Amendment to "Guide to hardwood log grading."** (Rev. 1965.) USDA For. Serv. Res. Note NE-81. 2 p.

1600. Ostrander, Myron D.
1971. **Eastern white pine** *(Pinus strobus* **L.).** U.S. Dep. Agric., For. Serv. Am. Woods Ser. FS-251. 4 p.

1601. Ostrander, Myron D., and Robert L. Brisbin.
1971. **Sawlog grades for eastern white pine.** USDA For. Serv. Res. Pap. NE-205. 25 p.

1602. Pack, J. C., and J. W. Thomas.
1970. **Calling all turkeys.** Wonderful W. Va. 34(8):16.

1603. Pack, James C., H. Reed Sanderson, and Robert W. Donohoe.
1971. **Comparison of gray squirrel census techniques.** Trans. Northeast Sect Wildl. Soc. Northeast Fish Wildl. Conf. p. 145-158.

1604. Parencia, C.R., Jr.
1976. **The pilot boll weevil eradication experiment.** *In* Proc. of the eighth annual northeastern forest insect work conference.USDA For. Serv. Gen. Tech. Rep. NE-27. p. 3-7.

1605. Parker, Homer W.
1966. **Balloon logging.** *In* Forest engineering symp. proc. W. Va. Univ. Tech. Bull. 82. p. 85-90.

1606. Parker, Homer W.
1966. **Human engineering aspects of machine selection and utilization.** *In* Forest engineering symp. proc. W. Va. Univ. Tech. Bull. 82. p. 25-29.

1607. Parker, Homer W.
1966. **New U.S. Forest Service unit applies engineering research to Appalachian logging.** North. Logger 14(10):16,57.

1608. Parker, Homer. W.
1966. **Rubber-tired skidders: Training needs.** North. Logger 14(11):16,39.

1609. Parker, Homer W.
1966. **Selection and use of forest machines.** *In* Forest engineering symp. proc. W. Va. Univ. Tech. Bull. 82. p. 50-55.

1610. Parker, Homer W.
1966. **Some cableway systems applicable to Appalachia.** *In* Forest engineering symp. proc. W. Va. Univ. Tech. Bull. 82. p. 73-79.

1611. Parker, Homer W., Harry G. Gibson, and Ross A. Phillips.
1967. **Wheeled skidder experiments in Appalachia.** 14th IUFRO Congr. Sect. 31-32. p. 364-384.

1612. Parker, J.
1970. **Heat effects on survival, respiration, and ultrastructure in tree twigs.** (Abstr.) Plant Physiol. 46 (Suppl.):22.

1613. Parker, Johnson.
1968. **Drought-resistance mechanisms.** *In* Water deficits and plant growth, vol. 1. T. T. Kozlowski, ed. Academic Press, New York. p. 195-234.

1614. Parker, Johnson.
1968. **Drought resistance of roots of white ash, sugar maple, and red oak.** USDA For. Serv. Res. Pap. NE-95. 9 p.

1615. Parker, Johnson.
1969. **Further studies of drought resistance in woody plants.** Bot. Rev. 35:317-371.

1616. Parker, Johnson.
1970. **Effects of defoliation and drought on root food reserves in sugar maple seedlings.** USDA For. Serv. Res. Pap. NE-169. 8 p.

1617. Parker, Johnson.
1971. **An unusual tonoplast in conifer leaves.** Nature 234(5326):231.

1617a. Parker, Johnson.
1972. **Heat resistance and respiratory response in twigs of some common tree species.** Bot. Gaz. 132:268-273.

1618. Parker, Johnson.
1972. **Protoplasmic resistance to water deficits.** *In* Water deficits and plant growth, vol. III. T.T. Kozlowski, ed. Academic Press, New York. p. 125-176.

1619. Parker, Johnson.
1972. **Spatial arrangements of some cryoprotective compounds in ice lattices.** Cryobiology 9:247-250.

1620. Parker, Johnson.
1974. **Effects of defoliation, girdling, and severing of sugar maple trees on root starch and sugar levels.** USDA For. Serv. Res. Pap. NE-306. 4 p.

1621. Parker, Johnson.
1974. **Seasonal changes in phenol-bound sugars in bark of some deciduous forest trees.** Can J. For. Res. 4:291-295.

1622. Parker, Johnson.
1974. **Seasonal changes in some bark pigments in** *Quercus velutina.* (Abstr.) Plant Physiol. 54 (Suppl.):33.

1623. Parker, Johnson, and David R. Houston.
1971. **Effects of repeated defoliation on root and root collar extractives of sugar maple trees.** For. Sci. 17:91-95.

1624. Parker, Johnson, and Roy L. Patton.
1975. **Effects of drought and defoliation on some metabolites in roots of black oak seedlings.** Can. J. For. Res. 5:457-463.

1625. Patric, J. H.
1966. **Rainfall interception by mature coniferous forests of southeast Alaska.** J. Soil & Water Conserv. 21:229-331.

1626. Patric, J. H.
1967. **Evaporation and transpiration.** Am. Geophys. Union Trans. 48: 701-707.

1627. Patric, J. H.
1968. **Review of "Role of forests in water conservation," by V. V. Rakhmanov.** J. Soil & Water Conserv. 23:189.

1628. Patric, J. H.
1970. **Some principles of forest hydrology pertinent to even-aged management of eastern hardwoods.** North. Logger 19:14-15, 26-27.

1629. Patric, J. H.
1975. **Timber harvest as an agent of forest stream channel modification.** *In* Symp. on stream channel modification proc. Harrisonburg, Va. p. 108-116.

1630. Patric, J. H.
1976. **Soil erosion in the eastern forest.** J. For. 74:671-677.

1631. Patric, James H.
1969. **Changes in streamflow, duration of flow, and water quality of two partially clearcut watersheds in West Virginia.** (Abstr.) Trans. Am. Geophys. Union 50(4):144.

1632. Patric, James H.
1970. **Combined weather and vegetation modification promises synergistic streamflow response.** J. Hydrol. 11:316-317.

1633. Patric, James H.
1970. **Logging roads and water quality.** Proc. For. Eng. Workshop on For. Roads. W. Va. Univ. (71) 1-4:11-16.

1634. Patric, James H.
1971. **Herbicides and water quality in American forestry.** Northeast. Weed Sci. Soc. Proc. 25. p. 365-375.

1635. Patric, James H.
1973. **Deforestation effects on soil moisture, streamflow, and water balance in the central Appalachians.** USDA For. Serv. Res. Pap. NE-259. 12 p.

1636. Patric, James H.
1974. **Multi-project research in the U.S. Forest Service.** *In* Caliper. p. 18-20.

1637. Patric, James H.
1974. **River flow increases in central New England after the hurricane of 1938.** J. For. 72:21-25.

1638. Patric, James H.
1974. **Soil water relationships in uncut and cut forests.** *In* Notebook for logging road and skid trail workshops. W. Va. Univ. Coop. Ext. Serv. 9 p.

1639. Patric, James H.
1974. **Water relations of some lysimeter-grown wildland plants in southern California.** USDA For. Serv. Northeast. For. Exp. Stn. 130 p.

1640. Patric, James H.
1975. **Announcement: Report on lysimeter studies at San Dimas Experimental Forest.** For. Sci. 21:195.

1641. Patric, James H.
1976. **Review of "Water pollution control in low density areas,"** William J. Jewell and Rita Swan, eds. J. For. 74:171.

1642. Patric, James H.
1976. **Effects of wood products harvest on forest soil and water resources with emphasis on clearcutting in moist climates.** *In* The Scientific base for silviculture and management decisions in the National Forest System: Selected papers. USDA For. Serv., Washington, D.C. p. 39-51.

1643. Patric, J. H., and John Campbell.
1969. **A substitute for 2,4,5-T in eastern hardwood sprout and brush control.** Northeast. Weed Control Conf. Proc. 23. p. 320-328.

1644. Patric, James H., and John Campbell.
1970. **Some experiences with Dicamba in controlling revegetation of deforested land in West Virginia.** Northeast. Weed Control Conf. Proc. 24. p. 61-68.

1645. Patric, James H., and Burley D. Fridley.
1963. **A device for measuring soil frost.** USDA For. Serv. Res. Note NE-94. 7 p.

1646. Patric, James H., and Niranjan Goswami.
1968. **Evaporation pan studies.** W. Va. Agric. For. 1(4):6-10.

1647. Patric, James H., and Ernest M. Gould.
1976. **Shifting land use and the effects on river flow in Massachusetts.** J. Am. Water Works Assoc. 68(1):41-45.

1648. Patric, James H., and Kenneth G. Reinhart.
1971. **Hydrologic effects of deforesting two mountain watersheds in West Virginia.** Water Resour. Res. 7:1182-1188.

1649. Patric, James H., and David W. Smith.
1975. **Forest management and nutrient cycling in eastern hardwoods.** USDA For. Serv. Res. Pap. NE-324. 12 p.

1650. Patric, J. H., and W. R. Studenmund.
1975. **Some seldom-reported statistics on precipitation at Elkins, West Virginia.** W. Va. Agric. For. 6(2):14-16.

1651. Patric, James H., and George R. Trimble, Jr.
1972. **Transition in research on small forested watersheds in West Virginia.** *In* Watersheds in transition. Am. Water Resour. Assoc. Symp. p. 272-275.

1652. Patterson, James C.
1976. **Soil compaction and its effects upon urban vegetation.** *In* Better trees for metropolitan landscapes symp. proc. USDA For. Serv. Gen. Tech. Rep. NE-22. p. 91-102.

1653. Payne, Brian R.
1973. **The twenty-nine tree home improvement plan.** Nat. Hist. 82(9):74-75.

1654. Payne, Brian R.
1976. **Landscaping adds dollars to your property values.** New Horizons 1976: 1. Hortic. Res. Inst. Washington, D.C.

1655. Payne, Brian, and Richard DeGraaf.
1975. **Economic values and recreational trends associated with human enjoyment of nongame birds.** Proc. Symp. Manage. For. Range Habitats Nongame Birds. USDA For. Serv. Gen. Tech. Rep. WO-1. p. 6-10.

1656. Payne, Brian R., Richard C. Gannon, and Lloyd C. Irland.
1975. **The second-home recreation market in the Northeast.** U.S. Dep. Inter. Bur. Outdoor Recreation. 27 p.

1657. Payne, Brian R., and Steven Strom.
1975. **The contribution of trees to the appraised value of unimproved residential land.** Valuation 22(2):37-45.

1658. Payne, Brian R., and Jack Ward Thomas.
1971. **New developments in environmental forestry research.** Tree Wardens, Arborists, and Utilities Conf. Proc. Univ. Mass., Amherst. p. 27-31.

1659. Payne, Brian R., and Jack W. Thomas. 1974. **Multiple use: Who is the public and what are they saying?** *In* University of Missouri timber-wildlife management symp. proc. Mo. Acad. Sci. Occas. Pap. 3. p. 108-111.

1660. Payne, Brian R., William B. White, Roger E. McCay, and Robert R. McNichols. 1973. **Economic analysis of the gypsy moth problem in the Northeast. II. Applied to residential property.** USDA For. Serv. Res. Pap. NE-285. 6 p.

1661. Peacock, J. W. 1971. *Scolytus multistriatus* **(Marsham) as a source of pheromone.** (Abstr.) Proc. North Cent. Branch Entomol. Soc. Am. 26:92.

1662. Peacock, John W. 1971. **The present status of research and controls for Dutch elm disease.** Assoc. Phys. Plant Admin. East. Reg. Annu. Meet. 20. 28 p.

1663. Peacock, John W. 1975. **Research on chemical and biological controls for elm bark beetles.** *In* Dutch elm disease. USDA For. Serv. Northeast. For. Exp. Stn. p. 18-49.

1664. Peacock, J. W., and R. A. Cuthbert. 1975. **Pheromone-baited traps for detecting the smaller European elm bark beetle.** USDA Coop. Econ. Insect. Rep. 25(24):497-500.

1665. Peacock, J. W., R. A. Cuthbert, W. E. Gore, G. N. Lanier, G. T. Pearce, and R. M. Silverstein. 1975. **Collection of Porapak Q of the aggregation pheromone of** *Scolytus multistriatus* **(Coleoptera: Scolytidae).** J. Chem. Ecol. 1:149-160.

1666. Peacock, John W., and Frank W. Fisk. 1970. **Phagostimulants for larvae of the mimosa webworm,** *Homadaula anisocentra.* Ann. Entomol. Soc. Am. 63:1755-1762.

1667. Peacock, John W., Bruce H. Kennedy, and Frank W. Fisk. 1967. **A bioassay technique for elm bark beetle feeding stimulants.** Ann. Entomol. Soc. Am. 60:480-481.

1668. Peacock, J. W., A. C. Lincoln, J. B. Simeone, and R. M. Silverstein. 1970. **Field attraction of** *Scolytus multistriatus* **(Coleoptera: Scolytidae) to a virgin-female-produced pheromone.** Miami Beach Meet. Entomol. Soc. Am. Abstr. p. 51.

1669. Peacock, John W., A. Charles Lincoln, John B. Simeone, and Robert M. Silverstein. 1971. **Attraction of** *Scolytus multistriatus* **(Coleoptera: Scolytidae) to a virgin-female-produced pheromone in the field.** Ann. Entomol. Soc. Am. 64:1143-1149.

1670. Peacock, J. W., R. M. Silverstein, A. C. Lincoln, and J. B. Simeone. 1973. **Laboratory investigations of the frass of** *Scolytus multistriatus* **(Coleoptera: Scolytidae) as a source of pheromone.** Environ. Entomol. 2:355-359.

1671. Pearce, G. T., W. E. Gore, and R. M. Silverstein. 1976. **Synthesis and absolute configuration of multistriatin.** J. Org. Chem. 41:2779-2803.

1672. Pearce, G. T., W. E. Gore, R. M. Silverstein, G. N. Lanier, J. B. Simeone, J. W. Peacock, and R. Cuthbert. 1974. **Aggregation pheromone of the smaller European elm bark beetle,** *Scolytus multistriatus.* Int. Union Pure and Appl. Chem. Int. Symp. Chem. Nat. Prod. 9:1E. Ottawa, Canada.

1673. Pearce, G. T., W. E. Gore, R. M. Silverstein, J. W. Peacock, R. A. Cuthbert, G. N. Lanier, and J. B. Simeone. 1975. **Chemical attractants for the smaller European elm bark beetle** *Scolytus multistriatus* **(Coleoptera: Scolytidae).** J. Chem. Ecol. 1:115-124.

1674. Peckham, David J. 1969. **A serological comparison of** *Pissodes strobi* **and** *P. approximatus.* Can. Entomol. 101:78-90.

1675. Pendleton, Thomas H. 1969. **Sales promotion in the natural Christmas tree industry.** Am. Christmas Tree J. 13(1):3-6.

1676. Pendleton, Thomas H.
1973. **Research needs in workmen's compensation.** For. Prod. J. 23(3):11-12.

1677. Pendleton, Thomas H., and Lawrence D. Garrett.
1969. **Competition: The artificial Christmas tree industry.** Cornell Univ. Sch. Christmas Tree Growers Proc. p. 51-59.

1678. Pendleton, Thomas H., and Lawrence D. Garrett.
1969. **"O Tannenbaum, O Tannenbaum" how phony all your needles are!** South. Lumberman 219 (2728): 128-129.

1679. Pendleton, Thomas H., and Lawrence D. Garrett.
1970. **Factors that influence Christmas tree sales.** USDA For. Serv. Res. Note NE-112. 5 p.

1680. Pendleton, Thomas H., and Lawrence D. Garrett.
1970. **Report on a strong substitute: The artificial Christmas tree.** Am. Christmas Tree J. 14(2):3-5.

1681. Pendleton, Thomas H., and Lawrence D. Garrett.
1971. **Factors that influence Christmas tree sales.** Christmas Merchandiser. p. 12, 14.

1682. Pendleton, Thomas H., and Lawrence D. Garrett.
1973. **Structure of an urban Christmas tree market.** USDA For. Serv. Res. Pap. NE-270. 6 p.

1683. Pennock, Rogert [Roger], Jr., Gene W. Wood, Paul W. Shogren, Jr., Kenneth Reinhart, Vernal C. Miles, and Paul Younkin.
1975. **The forest soil.** *In* Clearcutting in Pennsylvania. Pa. State Univ. Coll. Agric. Sch. For. Resour. p. 21-32.

1684. Peters, Robert C., and Robert W. Wilson, Jr.
1967. **The northeastern forest-inventory data-processing system. III. Operation of subsystem edit.** USDA For. Serv. Res. Pap. NE-71. 31 p.

1685. Peters, Robert C., and Robert W. Wilson, Jr.
1967. **The northeastern forest-inventory data-processing system. IV. Information for programmers subsystem edit.** USDA For. Serv. Res. Pap. NE-72. 9 p.

1686. Peters, Robert C., and Robert W. Wilson, Jr.
1967. **The northeastern forest-inventory data-processing system. VI. Operation of subsystem table.** USDA For. Serv. Res. Pap. NE-74. 25 p.

1687. Peters, Robert C., and Robert W. Wilson, Jr.
1967. **The northeastern forest-inventory data-processing system. VII. Information for programmers subsystem table.** USDA For. Serv. Res. Pap. NE-75. 22 p.

1688. Peters, Robert C., and Robert W. Wilson, Jr.
1967. **The northeastern forest-inventory data-processing system. IX. Operation of subsystem output.** USDA For. Serv. Res. Pap. NE-77. 18 p.

1689. Peters, Robert C., and Robert W. Wilson, Jr.
1967. **The northeastern forest-inventory data-processing system. X. Information for programmers subsystem output.** USDA For. Serv. Res. Pap. NE-78. 15 p.

1690. Philbrook, James S., James P. Barrett, and William B. Leak.
1973. **A stocking guide for eastern white pine.** USDA For. Serv. Res. Note NE-168. 3 p.

1691. Phillips, John J.
1966. **Site index of Delaware-Maryland sweetgum stands in relation to soil characteristics.** USDA For. Serv. Res. Note NE-48 5 p.

1692. Phillips, John J.
1966. **Site index of yellow-poplar related to soil and topography in southern New Jersey.** USDA For. Serv. Res. Pap. NE-52. 10 p.

1693. Phillips, Ross A.
1966. **Loading machines.** *In* Forest engineering symp. proc. W. Va. Univ. Tech. Bull. 82 p. 114-122.

1693a. Phillips, Ross A.
1969. **Discussion of public and private forest engineering roads.** For. Eng. Educ. Conf. ASAE Publ. Proc. 170. p. 54-55.

1694. Phillips, Ross A.
1970. **Potential of front-end log loaders.** Am. Soc. Agric. Eng. Winter Meet., Chicago. 12 p.

1695. Phillips, Ross A., and Cleveland J. Biller.
1971. **A meter/recorder to measure logging road roughness: Progress report.** USDA For. Serv. Eng. Tech. Inform. Syst. Field Notes 3(9):8-10.

1696. Phillips, Ross A., and Robert L. Hartman.
1970. **Log loading with a rubber-tired front-end loader.** North. Logger 19 (5):16-17, 26-27.

1697. Phillips, Ross A., and Richard A. Spray.
1966. **Wheeler skidder performance.** *In* Forest engineering symp. proc. W. Va. Univ. Tech. Bull. 82. p. 39-49.

1698. Phillips, W., G. Simmons, and T. Corcoran.
1976. **Spruce budworm and a computer-based mapping and information retrieval system.** Maine For. Rev. 9:13-15.

1699. Pierce, Robert S.
1967. **Evidence of overland flow on forest watersheds.** *In* International symp. on forest hydrology proc. Pergamon Press, Oxford, England. p. 247-253.

1700. Pierce, Robert S.
1967. **Water-quality problems related to timber culture and harvesting.** Munic. Watershed Manage. Symp. Proc. 1965. Univ. Mass. Coop. Ext. Serv. Publ. 446. p. 45-48.

1701. Pierce, Robert S.
1969. **Forest transpiration reduction by clearcutting and chemical treatment.** Northeast. Weed Control Conf. Proc. 23. p. 344-350.

1702. Pierce, Robert S.
1971. **Clearcutting and stream water.** N.H. For. Notes 106:9,13.

1703. Pierce, Robert S., J. W. Hornbeck, G. E. Likens, and F. H. Bormann.
1970. **Effect of elimination of vegetation on stream water quantity and quality.** *In* Symp. results of research on representative and experimental basins proc. Wellington, New Zealand. p. 311-328.

1704. Pierce, Robert S., C. Wayne Martin, Calvin C. Reeves, Gene E. Likens, and F. Herbert Bormann.
1972. **Nutrient loss from clearcuttings in New Hampshire.** *In* Watersheds in transition. Am. Water Resour. Assoc. Symp. p. 285-295.

1705. Pinchot Institute.
1973. **The Pinchot Institute system for environmental forestry studies.** USDA For. Serv. Gen. Tech. Rep. NE-2. 60 p.

1706. Plass, William T.
1966. **Land disturbances from strip-mining in eastern Kentucky. I. Upper Cumberland coal reserve district.** USDA For. Serv. Res. Note NE-52. 7 p.

1707. Plass, William T.
1967. **Land disturbances from strip-mining in eastern Kentucky. 2. Princess coal reserve district.** USDA For. Serv. Res. Note NE-55. 8 p.

1708. Plass, William T.
1967. **Land disturbances from strip-mining in eastern Kentucky. 3. Licking River coal reserve district.** USDA For. Serv. Res. Note NE-68. 6 p.

1709. Plass, William T.
1967. **Land disturbances from strip-mining in eastern Kentucky. 4. Big Sandy coal reserve district.** USDA For. Serv. Res. Note NE-69. 7 p.

1710. Plass, William T.
1967. **Land disturbances from strip-mining in eastern Kentucky. 5. Hazard coal reserve district.** USDA For. Serv. Res. Note NE-71. 7 p.

1711. Plass, William T.
1967. **Land disturbances from strip-mining in eastern Kentucky. 6. Southwestern coal reserve district.** USDA For. Serv. Res. Note NE-72. 8 p.

1712. Plass, William T.
1967. **Review of "Plant colonization studies on black waste from anthracite mining in Pennsylvania," by J. R. Schramm.** J. For. 64:820.

1713. Plass, William T.
1967. **Survey of eastern Kentucky.** Ky. Dep. Nat. Resour. Strip Min. Symp. Proc. 6 p.

1714. Plass, William T.
1968. **Tree survival and growth on fescue-covered spoil banks.** USDA For. Serv. Res. Note NE-90. 4 p.

1715. Plass, William T.
1969. **Pine seedlings respond to liming of acid strip-mine spoil.** USDA For. Serv. Res. Note NE-103. 8 p.

1716. Plass, William T.
1971. **Highwalls: An environmental nightmare.** *In* Revegetation and economic use of surface-mined land and mine refuse symp. proc. W. Va. Univ. Sch. Mines, Morgantown. p. 9-13.

1717. Plass, William T.
1972. **Fertilization treatments increase black locust growth on extremely acid surface-mine spoils.** Tree Plant. Notes 23(4):10-12.

1718. Plass, William T.
1973. **Chemical soil stabilizers for surface mine reclamation.** *In* Soil erosion: Causes and mechanisms; prevention and control. Workshop Conf. Proc. Highw. Res. Board Spec. Rep. 135. Washington, D.C. p. 118-122.

1719. Plass, William T.
1973. **Genetic variability in survival and growth of Virginia pine planted on acid surface-mine spoil.** *In* Ecology and reclamation of devastated land, vol. I. Gordon & Breach, New York. p. 493-504.

1720. Plass, William T.
1973. **Revegetating surface-mined land.** Coal Min. & Process. 10(7):54-55.

1721. Plass, William T.
1974. **Factors affecting the establishment of direct-seeded pine on surface-mine spoils.** USDA For. Serv. Res. Pap. NE-290. 5 p.

1722. Plass, William T.
1974. **Revegetation projects dominate surface-mine research.** Coal Min. & Process. 11(8):40-42.

1723. Plass, William T.
1974. **Revegetating surface-mined land.** Min. Cong. J. 60(4):53-59.

1724. Plass, William T.
1975. **An evaluation of trees and shrubs for planting surface-mine spoils.** USDA For. Serv. Res. Pap. NE-317. 8 p.

1725. Plass, William T.
1975. **Changes in water chemistry resulting from surface-mining of coal on four West Virginia watersheds.** Natl. Coal Assoc. Surface Min. and Reclam. Symp. 3 (vol. 1):152-169.

1726. Plass William T.
1975. **Reclamation of surface-mined land.** Ohio J. Sci. 75:298-304.

1727. Plass, William T.
1976. **Direct seeding of trees and shrubs on surface-mined lands in West Virginia.** Forestation of Disturbed Surface Areas Conf. Proc. Birmingham, Ala. p. 32-42.

1728. Plass, William T., and Stephen G. Boyce.
1976. **Aesthetic forests for urban areas.** Parks & Recreation 2(10):42,73,90.

1729. Plass, W. T., and J. D. Burton.
1967. **Pulpwood production potential on strip-mined land in the South.** J. Soil & Water Conserv. 22:235-238.

1730. Plass, William T., and John P. Capp.
1974. **Physical and chemical characteristics of surface mine spoil treated with fly ash.** J. Soil & Water Conserv. 29:119-121.

1731. Plass, William T., and Willis G. Vogel.
1973. **Chemical properties and particle-size distribution of 39 surface-mine spoils in southern West Virginia.** USDA For. Serv. Res. Pap. NE-276. 8 p.

1732. Podgwaite, John D.
1976. **Field and laboratory identification of insect pathogens.** *In* Proc.

eighth annual northeastern forest insect work conference. USDA For. Serv. Gen. Tech. Rep. NE-27. p. 20.

1733. Podgwaite, John D., and Robert W. Campbell.
1971. **Disease in natural gypsy moth populations.** 4th Int. Colloq. Insect Pathol. p. 279-284.

1734. Podgwaite, J. D., and R. W. Campbell.
1972. **The disease complex of the gypsy moth. II. Aerobic bacterial pathogens.** J. Invertebr. Pathol. 20:303-308.

1735. Podgwaite, John D., and Benjamin J. Cosenza.
1966. **Bacteria of living and dead larvae of *Porthetria dispar* (L.).** USDA For. Serv. Res. Note NE-50. 7 p.

1736. Podgwaite, J. D., and B. J. Cosenza.
1976. **A strain of *Serratia marcescens* pathogenic for larvae of *Lymantria dispar:* Characterization.** J. Invertebr. Pathol. 27:185-190.

1737. Podgwaite, J. D., and B. J. Cosenza.
1976. **A strain of *Serratia marcescens* pathogenic for larvae of *Lymantria dispar:* Infectivity and mechanisms of pathogenicity.** J. Invertebr. Pathol. 27:199-208.

1738. Podgwaite, J. D., R. D. Neely, and R. T. Zerillo.
1974. **Reusable, autoclavable silicone rubber dish for insect dissection.** J. Econ. Entomol. 67:458-459.

1739. Pogge, Franz L.
1967. **Elm as deer browse.** J. Wildl. Manage. 31:354-356.

1740. Pogge, Franz L.
1970. **Rooting sassafras cuttings.** Tree Plant. Notes 21(2):28-29.

1741. Pogge, Franz L.
1973. **Greenbriers: Great for wildlife.** Pa. Game News 44(7):29-31.

1742. Pogge, Franz L.
1975. **Sassafras for wildlife.** Pa. Game News 46(7):17-19.

1743. Pogge, Franz L.
1976. **Review of "Shrubs and vines for northeastern wildlife."** Castanea 41:272-273.

1744. Pogge, Franz L., John D. Gill, and Bradford C. Bearce.
1974. **Gibberellic acid inhibits greenbrier growth.** Tree Plant. Notes 25(2):10.

1745. Pogge, Franz L., John D. Gill, and Bradford C. Bearce.
1974. **Rooting common and cat greenbrier.** USDA For. Serv. Res. Note NE-189. 6 p.

1746. Post, Boyd W., Willard H. Carmean, and Robert O. Curtis.
1969. **Birch soil-site requirements.** *In* Birch symp. proc. USDA For. Serv. Northeast. For. Exp. Stn. p. 95-101.

1747. Pottle, W. H., and A. L. Shigo.
1974. **Treatment of wounds on *Acer rubrum* with *Trichoderma viride*.** (Abstr.) Plants and Gard. 29(4):14-15.

1748. Pottle, William H., and Alex L. Shigo.
1975. **Treatment of wounds on *Acer rubrum* with *Trichoderma viride*.** Europ. J. For. Pathol. 5:274-279.

1749. Prausa, Robert L.
1971. **Multiple-use management for recreation in the East.** *In* Recreation symp. proc. USDA For. Serv. Northeast. For. Exp. Stn. p. 96-102.

1750. Quigley, Kenneth L.
1968. **A new look at Ohio's forest resources and industries.** Ohio Woodlands 6(3):5-8.

1751. Quigley, Kenneth L.
1971. **The supply and demand situation for oak timber,** *In* Oak symp. proc. USDA For. Serv. Northeast. For Exp. Stn. p. 30-36.

1752. Quigley, Kenneth L., and Harold M. Babcock.
1969. **Birch timber resources of North America.** *In* Birch symp. proc. USDA For. Serv. Northeast. For. Exp. Stn. p. 6-14.

1753. Quigley, Kenneth L., and Ronald D. Lindmark.
1966. **Timber resources.** *In* **Black walnut culture.** USDA For. Serv. North Cent. For. Exp. Stn. Walnut Workshop. p. 6-12.

1754. Quigley, Kenneth L., and Ronald D. Lindmark.

1967. **A look at black walnut timber resources and industries.** USDA For. Serv. Resour. Bull. NE-4. 28 p.

1755. Quigley, Kenneth L., and James T. Morgan.
1969. **Sugar maple timber resources.** *In* Proceedings sugar maple conference, 1968. Mich. Tech. Univ., Houghton. p. 3-8.

1756. Rammrath, Rita M.
1969. **Curbing insects to save tomorrow's trees.** Ohio Woodlands 7(3):2-3.

1757. Rammrath, Rita M.
1969. **Tuliptree scale.** Ohio Woodlands 7(3):11.

1758. Rammrath, Rita M.
1973. **Some predictions about natural Christmas trees.** South. Lumberman 226(2801):15-16.

1759. Rammrath, Rita M.
1973. **This researcher talks turkey.** For. Farmer 32(4):8.

1760. Rammrath, Rita M., and Walter R. Gooley, Jr.
1973. **So distinguished a forest! Only in Maine.** Maine For. Dep. and USDA For. Serv. Northeast. For. Exp. Stn. 28 p.

1761. Rast, Everette D.
1971. **Preliminary work in developing sawbolt grading systems for white oak.** USDA For. Serv. Res. Pap. NE-193. 14 p.

1762. Rast, Everette D.
1974. **Log and tree sawing times for hardwood mills.** USDA For. Serv. Res. Pap. NE-304. 17 p.

1763. Rast, Everette D.
1974. **Nonproductive time in hardwood mills.** South. Lumberman 229(2843):13-15.

1764. Rast, Everette D.
1975. **Preliminary hardwood log veneer grades for yellow birch and sugar maple face veneer.** Proc. 3rd Annu. Hardwood Symp. Hardwood Res. Counc. p. 84-94.

1765. Rast, Everette D., David L. Sonderman, and Glenn L. Gammon.
1973. **A guide to hardwood log grading.** (Rev.) USDA For. Serv. Gen. Tech. Rep. NE-1. 32 p.

1766. Rauschenberger, J. L., and R. L. Talerico.
1967. **Egg parasitism of the fall cankerworm.** J. Econ. Entomol. 60:881-882.

1767. Rawson, James W.
1974. **Willow.** *In* Shrubs and vines for northeastern wildlife. USDA For. Serv. Gen. Tech. Rep. NE-9. p. 147-149.

1768. Reardon, R. C.
1973. **A survey for tachinid parasitoids of the gypsy moth on Cape Cod, Massachusetts.** Environ. Entomol. 2:964-965.

1769. Reardon, R. C., and J. D. Podgwaite.
1976. **Disease: Parasitoid relationships in natural populations of *Lymantria dispar* (Lep.: Lymantriidae) in the northeastern United States.** Entomophaga 21:333-341.

1770. Reardon, R. C., W. W. Statler, and W. H. McLane.
1973. **Rearing techniques and biology of five gypsy moth parasites.** Environ. Entomol. 2:124-127.

1771. Redman, John C., and Vincent Cusumano.
1973. **Monetary conditions and the U.S. lumber and wood products industry.** Univ. Ky. Agric. Exp. Stn. Res. Rep. 15. 30 p.

1772. Reethof, G., L. D. Frank, and O. H. McDaniel.
1976. **Absorption of sound by tree bark.** USDA For. Serv. Res. Pap. NE-341. 6 p.

1773. Reethof, Gerhard, and Gordon M. Heisler.
1976. **Trees and forests for noise abatement and visual screening.** *In* Better trees for metropolitan landscapes symp. proc. USDA For. Serv. Gen. Tech. Rep. NE-22. p. 39-48.

1774. Reigner, Irvin C.
1966. **A method of estimating streamflow loss by evapotranspiration from the riparian zone.** For. Sci. 12:130-139.

1775. Reigner, Irvin C.
1967. **Effect of recreation on water quality.** Munic. Watershed Manage. Symp. Proc. 1965. Univ. Mass. Coop. Ext. Serv. Publ. 446. p. 49-55.

1776. Reigner, Irvin C.
1967. **Summary of discussions on new instruments.** *In* International symp. on forest hydrology proc. Pergamon Press, Oxford, England. p. 807-808.

1777. Reigner, Irvin C., and Louis G. Ningard.
1967. **Baltimore's watersheds: An example of integrated land use.** J. Am. Water Works Assoc. 59:1469-1477.

1778. Reigner, Irvin C., William E. Sopper, and Roy R. Johnson.
1968. **Will the use of 2,4,5-T to control streamside vegetation contaminate public water supplies?** J. For. 66:914-918.

1779. Reinhart, K. G.
1967. **Increasing water production through manipulation of vegetation.** Munic. Watershed Manage. Symp. Proc. 1965. Univ. Mass. Coop. Ext. Serv. Publ. 446. p. 17-26.

1780. Reinhart, K. G.
1970. **Status of findings on effects of deforestation and reforestation, eastern United States.** (Abstr.) Am. Geophys. Union Trans. 51(4):289.

1781. Reinhart, K. G.
1973. **Timber-harvest clearcutting and nutrients in the northeastern United States.** USDA For. Serv. Res. Note NE-170. 5 p.

1782. Reinhart, Kenneth G.
1967. **Watershed calibration methods.** *In* International symp. on forest hydrology proc. Pergamon Press, Oxford, England. p. 715-723.

1783. Reinhart, Kenneth G.
1971. **What's new in forest influences on the environment.** Proc. Winter Meet. Allegheny Sect. Soc. Am. For. p. 7-10.

1784. Reinhart, Kenneth G.
1972. **Effects of clearcutting upon soil/water relations.** *In* A perspective on clearcutting in a changing world. Proc. Winter Meet. N.Y. Sect. Soc. Am. For. SUNY Coll. For., Syracuse. AFRI Misc. Rep. 4. p. 67-74.

1785. Reinhart, Kenneth G.
1973. **Critique: Forest fertilization impacts on water and the environment.** *In* Forest fertilization symp. proc. USDA For. Serv. Gen. Tech. Rep. NE-3. p. 242-246.

1786. Reinhart, Kenneth G.
1975. **Throughout the Northeast: An overview.** *In* Municipal watershed management symp. proc. USDA For. Serv. Gen. Tech. Rep. NE-13. p. 79-83.

1787. Reinhart, K. G., A. R. Eschner, and G. R. Trimble, Jr.
[1967] **Effect on streamflow of four forest practices in the mountains of West Virginia.** (In Japanese.) Miyaqi Prefecture For. Conserv. Coop. Assoc., Japan. 52 p.

1788. Reinhart, K. G., and H. W. Lull.
1969. **Forests and floods: A reconsideration.** (Abstr.) Proc. Annu. Meet. Soc. Am. For. p. 19-20.

1789. Rennie, Peter J.
1973. **Critique: Forest fertilization —retrospect and prospect.** *In* Forest fertilization symp. proc. USDA For. Serv. Gen. Tech. Rep. NE-3. p. 234-241.

1790. Rex, Edgar G.
1976. **A municipal arborist selects trees for street planting.** *In* Better trees for metropolitan landscapes symp. proc. USDA For. Serv. Gen. Tech. Rep. NE-22. p. 9-11.

1791. Rexrode, C. O.
1967. **Preliminary study on the time and frequency of oak bark beetle attacks on oak wilt trees.** Plant Dis. Rep. 51:755-757.

1792. Rexrode, C. O.
1976. **Insect transmission of oak wilt.** J. Arboric. 2(4):61-66.

1793. Rexrode, Charles O.
1968. **Tree-wounding insects as vectors of the oak wilt fungus.** For. Sci. 14:181-189.

1794. Rexrode, Charles O.
1969. **Population increase of two species of *Pseudopityophthorus* in oak branches.** Ann. Entomol. Soc. Am. 62:448-449.

1795. Rexrode, Charles O.
1969. **Seasonal development and**

habits of *Pseudopityophthorus* spp. (Coleoptera: Scolytidae) in southern Ohio. Can. Entomol. 101:306-313.

1796. Rexrode, Charles O.
1971. **Insect damage to oaks.** *In* Oak symp. proc. USDA For. Serv. Northeast. For. Exp. Stn. p. 129-134.

1797. Rexrode, Charles O.
1974. **Effect of pressure-injected oxydemetonmethyl, cacodylic acid, and 2,4-D amine on elm bark beetle populations in elms infected with Dutch elm disease.** Plant Dis. Rep. 58:382-384.

1798. Rexrode, Charles O., and Robert E. Frame.
1973. **The effect of two oak wilt control methods on oak bark beetle populations, mat production, and disease incidence.** Plant Dis. Rep. 57:1055-1058.

1799. Rexrode, Charles O., and Thomas W. Jones.
1970. **Oak bark beetles: Important vectors of oak wilt.** J. For. 68:294-297.

1800. Rexrode, Charles O., and Thomas W. Jones.
1971. **Oak bark beetle attacks on oak wilt trees in Missouri.** Environ. Entomol. 1:57-58.

1801. Rexrode, Charles O., and Thomas W. Jones.
1971. **Oak bark beetles carry the oak wilt fungus in early spring.** Plant Dis. Rep. 55:108-111.

1802. Rexrode, C. O., T. W. Jones, R. R. Jones.
1972. **Overwintering stages and spring emergence of *Pseudopityophthorus* spp. in Missouri and West Virginia.** J. Econ. Entomol. 65:1520.

1803. Rexrode, Charles O., and Charles R. Krause.
1968. **Rearing larvae of *Pseudopityophthorus pruinosus* and *P. minutissimus* on ground phloem media.** Ann. Entomol. Soc. Am. 61:814-816.

1804. Rexrode, Charles O., and Charles R. Krause.
1968. **Serial sections of *Pseudopityophthorus* spp.** Ann. Entomol. Soc. Am. 61:1340-1341.

1805. Rexrode, Charles O., and James W. Lockyer.
1974. **Laboratory assay of cacodylic acid and Meta-Systox-R on *Scolytus multistriatus* and *Pseudopityophthorus* sp.** USDA For. Serv. Res. Note NE-190. 4 p.

1806. Reynolds, Hugh W.
1968. **Grading and unitized seasoning of oak cuttings.** Wood and Wood Prod. 73(10):34.

1807. Reynolds, Hugh W.
1969. **The SHOLO SHOrt LOg) Mill.** South. Lumberman 219(2728): 182-185.

1808. Reynolds, Hugh W.
1970. **Sawmill simulation: Data instructions and computer programs.** USDA For. Serv. Res. Pap. NE-152. 41 p.

1809. Reynolds, Hugh W.
1970. **The SHOLO (SHOrt LOg) mill.** North. Logger 18(9):10-12.

1810. Reynolds, Hugh W.
1971. **Manufacture of industrial products from oak.** *In* Oak symp. proc. USDA For. Serv. Northeast. For. Exp. Stn. p. 103-105.

1811. Reynolds, Hugh W.
1974. **Optimum sawing patterns for low-grade hardwoods.** *In* Use of computers in forestry, annual forestry symp. Baton Rouge, La. p. 119-134.

1812. Reynolds, Hugh W.
1976. **Pulpwood for furniture parts.** Furniture Des. Manuf. 48(9):182-184,186.

1813. Reynolds, Hugh W., and Charles J. Gatchell.
1969. **Sawmill simulation: Concepts and computer use.** USDA For. Serv. Res. Note NE-100. 5 p.

1814. Reynolds, Hugh W., and Charles J. Gatchell.
1970. **The SHOLO mill: Make pallet parts and pulp chips from low-grade hardwoods.** USDA For. Serv. Res. Pap. NE-180. 16 p.

1815. Reynolds, Hugh W., and Charles J. Gatchell.
1971. **The SHOLO mill: Return on investment versus mill design.** USDA For. Serv. Res. Pap. NE-187. 46 p.

1816. Reynolds, Hugh W., and Charles J. Gatchell.
1971. **Think twice, cut once to profit from low-grade logs.** Wood & Wood Prod. 76(9). 4 p.

1817. Reynolds, P. E., W. H. Smith, and K. F. Jensen.
1972. **Effect of constant and fluctuating temperatures on the growth in vitro of *Ceratocystis* species.** Trans. Brit. Mycol. Soc. 59(1):1-9.

1818. Reynolds, P. E., W. H. Smith, and K. F. Jensen.
1972. **Influence of constant and fluctuating temperatures on the growth of *Macrophomina phaseoli*.** Trans. Brit. Mycol. Soc. 58(3):512-515.

1819. Richards, Norman A., and Raymond E. Leonard.
1973. **Urban forestry and recreation developments in relation to fertilization.** *In* Forest fertilization symp. proc. USDA For. Serv. Gen. Tech. Rep. NE-3. p. 111-116.

1820. Richenderfer, James L., William E. Sopper, and Louis T. Kardos.
1975. **Spray-irrigation of treated municipal sewage effluent and its effect on the chemical properties of forest soils.** USDA For. Serv. Gen. Tech. Rep. NE-17. 24 p.

1821. Richeson, J. S., J. L. Nation, and R. C. Wilkinson.
1971. **Fatty acid composition in *Ips calligraphus* (Coleoptera: Scolytidae) during postembryonic development.** Ann. Entomol. Soc. Am. 64:251-254.

1822. Richeson, J. S., R. C. Wilkinson, and J. L. Nation.
1970. **Development of *Ips Calligraphus* on foliage-based diets.** J. Econ. Entomol. 63:1797-1799.

1823. Riddle, Jane.
1975. **Opportunities for reclaiming strip-mined forest lands.** For. Farmer 35(4):6-8.

1824. Riddle, Jane R., George H. Moeller, and William H. Smith.
1976. **Breaking new ground in urban America.** Am. For. 83(11):26-30,66.

1825. Rier, John P., and Alex L. Shigo.
1971. **Some early wounding responses in red maple, *Acer rubrum*.** (Abstr.) Am. J. Bot. 58:456.

1826. Rier, J. P., and A. L. Shigo.
1972. **Some changes in red maple, *Acer rubrum*, tissues within 34 days after wounding in July.** Can. J. Bot. 50:1783-1784.

1827. Roach, B. A.
1967. **Some effects of forest management practices on timber income.** Ky. Governor's Conf. For. Proc. 4. p. 65-70.

1828. Roach, B. A.
1973. **Clearcutting in hardwoods.** Va. For. 27(4):7-11,16.

1829. Roach, Ben A.
1968. **Is clear cutting good or bad?** Keep Ky. Green J. 8(4):5.

1830. Roach, Benjamin A.
1966. **Is even-aged management practical for small woodlands in the Central States?** *In* Forest resource decisions in a changing power structure. Proc. Soc. Am. For. 1965. p. 151-154.

1831. Roach, Benjamin A.
1974. **Scheduling timber cutting for sustained yield of wood products and wildlife.** University of Missouri timber and wildlife management symp. proc. Mo. Acad. Sci. Occas. Pap. 3. p. 33-43.

1832. Roach, Benjamin A.
1974. **Selection cutting and group selection.** SUNY Coll. Environ. Sci. and For. Appl. For. Res. Inst. Misc. Rep. 5. 9 p.

1833. Roach, Benjamin A.
1975. **Scheduling timber cutting for sustained yield of wood products and wildlife.** USDA For. Serv. Gen. Tech. Rep. NE-14. 13 p.

1834. Roach, Benjamin A.
1975. **Foreword.** *In* Clearcutting in Pennsylvania. Pa. State Univ. Coll. Agric. Sch. For. Resour. p. ix-xii.

1835. Roach, B. A., and S. F. Gingrich.
1967. **Upland hardwoods can be grown efficiently.** 1967 Pulpwood Annu. p. 85-87.

1836. Roach, Benjamin A., and Samuel F. Gingrich.
1968. **Even-aged silviculture for upland central hardwoods.** U.S. Dep. Agric., Agric. Handb. 355. 39 p.

1837. Roberts, Bruce R., and Keith F. Jensen.
1970. **The influence of Dutch elm disease and plant water stress on the foliar nutrient content of American and Siberian elm.** (Abstr.) 1st North Am. For. Biol. Workshop. Mich. State Univ., East Lansing.

1838. Roberts, Bruce R., and Keith F. Jensen.
1970. **The influence of Dutch elm disease and plant water stress on the foliar nutrient content of American and Siberian elm.** Phytopathology 60:1831-1833.

1838a. Roberts, B. R., A. M. Townsend, and L. S. Dochinger.
1971. **Photosynthetic response to SO_2 fumigation in red maple.** (Abstr. Pap. 179). Plant Physiol. 47:30.

1839. Robinette, Sadie L.
1974. **Checkerberry wintergreen.** *In* Shrubs and vines for northeastern wildlife. USDA For. Serv. Gen. Tech. Rep. NE-9. p. 20-22.

1840. Robinette, Sadie L.
1974. **Mountain-laurel.** *In* Shrubs and vines for northeastern wildlife. USDA For. Serv. Gen. Tech. Rep. NE-9. p. 102-105.

1841. Robinette, Sadie L.
1974. **Rhododendron.** *In* Shrubs and vines for northeastern wildlife. USDA For. Serv. Gen. Tech. Rep. NE-9. p. 113-115.

1842. Rogers, Robert.
1974. **Blueberries.** *In* Shrubs and vines for northeastern wildlife. USDA For. Serv. Gen. Tech. Rep. NE-9. p. 12-15.

1843. Rollins, James A.
1974. **Viburnums.** *In* Shrubs and vines for northeastern wildlife. USDA For. Serv. Gen. Tech. Rep. NE-9. p. 140-146.

1844. Rollinson, W. D., H. B. Hubbard, Jr., and F. B. Lewis.
1970. **Mass rearing of the European pine sawfly for production of the nuclear polyhedrosis virus.** J. Econ. Entomol. 63:343-344.

1845. Rollinson, William D., and Franklin B. Lewis.
1973. **Susceptibility of gypsy moth larvae to *Lymantria* spp. nuclear and cytoplasmic polyhedrosis viruses.** Plant Prot. 24(124-125):163-168.

1846. Romberger, J. A.
1976. **An appraisal of prospects for research on juvenility in woody perennials.** Acta Hortic. 56:301-317.

1847. Romberger, John A.
1974. **Review of "Plant physiology: A treatise."** Vol. 6C. Physiology of development: From seeds to sexuality. For. Sci. 20:214.

1848. Romberger, J. A., and R. A. Gregory.
1974. **Analytical morphogenesis and the physiology of flowering in trees.** North Am. For. Biol. Workshop Proc. 3:132-147. Fort Collins, Colo.

1849. Romberger, J. A., and C. A. Tabor.
1973. **Accumulation of externally polymerized polysaccharide beneath *Picea abies* Shoot apical domes in culture.** (Abstr.) Am. J. Bot. 60 (suppl.):13.

1850. Romberger, J. A., and C. A. Tabor.
1975. **The *Picea abies* shoot apical meristem in culture. II. Deposition of polysaccharides and lignin-like substances beneath cultures.** Am. J. Bot. 62:610-617.

1851. Romberger, J. A., and C. A. Tabor.
1976. **A system for studying the synthesis of lignin and related substances by meristem culture.** Appl. Polymer Symp. 28. p. 1065-1074.

1852. Ross, Robert S.
1976. **Role of cultivars in a roadside planting and maintenance program.** *In* Better trees for metropolitan landscapes symp. proc. USDA For. Serv. Gen. Tech. Rep. NE-22. p. 149-157.

1853. Ross, Terence L., and George H. Moeller.
1974. **Communicating rules in recreation areas.** USDA For. Serv. Res. Pap. NE-297. 12 p.

1854. Rudolf, Paul O., and W. B. Leak.
1974. ***Fagus* L.: Beech.** *In* Seeds of woody plants in the United States. U.S. Dep. Agric., Agric. Handb. 450. p. 401-405.

1855. Rushmore, Francis M.
1969. **Sapsucker damage varies with tree species and seasons.** USDA For. Serv. Res. Pap. NE-136. 19 p.

1856. Rushmore, Francis M.
1971. **Effects of Accothion on birds (intensive studies on sapsuckers).** *In* Environmental studies of Accothion for spruce budworm control. p. 88-100.

1857. Rushmore, Francis M.
1973. **Techniques for calling sapsuckers and finding their nesting territories.** USDA For. Serv. Res. Pap. NE-281. 7 p.

1858. Russell, T. E.
1971. **Seeding and planting upland oaks.** *In* Oak symp. proc. USDA For. Serv. Northeast. For. Exp. Stn. p. 49-54.

1859. Rutherford, William Jr., and Elwood L. Shafer, Jr.
1969. **Selection cuts increased natural beauty in two Adirondack forest stands.** J. For. 67:415-419.

1860. Ryan, John J.
1976. **Design considerations in the selection of cultivars for metropolitan highways.** *In* Better trees for metropolitan landscapes symp. proc. USDA For. Serv. Gen. Tech. Rep. NE-22. p. 143-148.

1861. Sabrosky, Curtis W., and Richard C. Reardon.
1976. **Tachinid parasites of the gypsy moth,** *Lymantria dispar*, with keys to adults and puparia. Entomol. Soc. Am. Misc. Publ. 10(2). 126 p.

1862. Safford, L. O.
1970. **Dry weight and nutrient content of red spruce needles influenced by urea fertilization and soil type.** (Abstr.) 1st North Am. For. Biol. Workshop. Mich. State Univ., East Lansing.

1863. Safford, L. O.
1973. **Fertilization increases diameter growth of birch-beech-maple trees in New Hampshire.** USDA For. Serv. Res. Note NE-182. 4 p.

1864. Safford, L. O.
1973. **Forest fertilization in the eastern United States: Conifers.** *In* Forest fertilization symp. proc. USDA For. Serv. Gen. Tech. Rep. NE-3. p. 206-210.

1865. Safford, L. O.
1974. **Effect of fertilization on biomass and nutrient content of fine roots in a birch-beech-maple stand.** Plant and Soil 40:349-363.

1866. Safford, L. O.
1974. ***Picea* A. Dietr.: Spruce.** *In* Seeds of woody plants in the United States. U.S. Dep. Agric., Agric. Handb. 450. p. 587-597.

1867. Safford, L. O.
1974. **Seasonal variation in growth and nutrient content of yellow birch layer roots.** North Am. For. Biol. Workshop Proc. 3:351. Fort Collins, Colo.

1868. Safford, L. O.
1976. **Seasonal variation in the growth and nutrient content of yellow birch replacement roots.** Plant and Soil 44:439-444.

1869. Safford, Lawrence O.
1968. **Ten-year average growth rates in the spruce-fir region of northern New England.** USDA For. Serv. Res. Pap. NE-93. 20 p.

1870. Stafford, L.O., and Susan Bell.
1972. **Biomass of fine roots in a white spruce plantation.** Can. J. For. Res. 2:169-172.

1871. Safford, L. O., and S. M. Filip.
1974. **Biomass and nutrient content of 4-year-old fertilized and unfertilized northern hardwood stands.** Can. J. For. Res. 4:549-554.

1872. Safford, Lawrence O., Robert M. Frank, and Elbert L. Little, Jr.
1969. **Trees and shrubs of the**

Penobscot Experimental Forest, Penobscot County, Maine. USDA For. Serv. Res. Pap. NE-128. 27 p.

1873. Safford, L. O., Alex L. Shigo, and Marilyn Ashley.
1974. **Gradients of cation concentration in discolored and decayed wood of red maple.** Can. J. For. Res. 4:435-440.

1874. Safford, Lawrence O., and Harold E. Young.
1968. **Nutrient content of the current foliage of red spruce growing on three soils in Maine.** Res. Life Sci. p. 27-31.

1875. Sailer, R. I.
1971. **Invertebrate predators.** *In* Toward integrated control. Proc. 3rd Annu. Northeast. For. Insect Work Conf. USDA For. Serv. Res. Pap. NE-194. p. 32-44.

1876. Sander, Ivan L.
1966. **Natural reproduction.** *In* Black walnut culture. USDA For. Serv. North Cent. For. Exp. Stn. Walnut Workshop. p. 18-19.

1877. Sander, Ivan L.
1967. **Composition and distribution of hardwood reproduction after harvest cutting.** *In* Symp. on hardwoods of the Piedmont and Coastal Plain Proc. Ga. For. Res. Counc. p. 30-33.

1878. Sander, Ivan L.
1971. **Height growth of new oak sprouts depends on size of advance reproduction.** J. For. 69:809-811.

1879. Sander, Ivan L., and F. Bryan Clark.
1971. **Reproduction of upland hardwood forests in the central states.** U.S. Dep. Agric., Agric. Handb. 405. 25 p.

1880. Sanderson, H. Reed.
1975. **Den-tree management for gray squirrels.** Wildl. Soc. Bull. 3(3):125-131.

1881. Sanderson, H. Reed, and Larry A. Berry.
1972. **A 2-acre enclosure for tree squirrel research.** Southeast. Assoc. Game and Fish Comm. 26th Annu. Conf. Proc. p. 298-300.

1882. Sanderson, H. Reed, and Larry A. Berry.
1973. **Gray squirrels reproduce in a 2-acre enclosure.** USDA For. Serv. Res. Note NE-174. 6 p.

1883. Sanderson, H. Reed, William M. Healy, James C. Pack, John D. Gill, and Jack W. Thomas.
1976. **Gray squirrel habitat and nest-tree preference.** Southeast. Assoc. Game and Fish Comm. 30th Annu. Conf. Proc. p. 609-616.

1884. Santamour, Frank S., Jr.
1967. **Growth and characteristics of some hybrid spruces.** Univ. Pa. Morris Arbor. Bull. 18(1):18-20.

1885. Santamour, Frank S., Jr.
1976. **Breeding and selecting better trees for metropolitan landscapes.** *In* Better trees for metropolitan landscapes symp. proc. USDA For. Serv. Gen. Tech. Rep. NE-22. p. 1-8.

1886. Santamour, Frank S., Jr.
1976. **Perspectives on improvement strategies for metropolitan trees.** *In* Better trees for metropolitan landscapes symp. proc. USDA For. Serv. Gen. Tech. Rep. NE-22. p. 215-220.

1887. Santamour, Frank S., Jr., and Arnold D. Rhodes.
1966. **A trial of pales weevil resistance.** Tree Plant. Notes 76:21-23.

1888. Sardo, William H., Jr., and Walter B. Wallin.
1974. **The performance of wooden pallets in pallet exchange programs.** Natl. Wooden Pallet and Container Assoc., Washington, D.C. 37 p.

1889. Sarles, R. L.
1966. **Study shows lumber preferences of three user groups.** Wood and Wood Prod. 71(8):39-40.

1890. Sarles, R. L.
1966. **Tailor production to fit customer's needs.** South. Lumberman 212(2642):12,14,16.

1891. Sarles, R. L.
1968. **Components of a successful wood business: the marketing component.** Ky. Governor's Conf. For. Proc. 5. p. 83-87.

1892. Sarles, R. L.
1969. **High costs of improper seasoning.** Woodworking Dig. 71(7):34-35.

1893. Sarles, Raymond L.
1969. **Economic aspects of bark utilization.** *In* Making and selling bark products. For. Prod. Res. Soc. Symp. p. 24-44.

1894. Sarles, Raymond L.
1973. **Bark: A Cinderella story.** North. Logger 21(9):14-15, 36.

1895. Sarles, Raymond L.
1973. **Using and marketing bark residues.** For. Prod. J. 23(8):10-14.

1896. Sarles, Raymond L.
1974. **The use and value of wood and bark residues in the Northeast, *or* "Thar's gold in them thar bark piles."** North. Logger 23(2):22-23,38-39.

1897. Sarles, Raymond L.
1974. **Using and marketing bark residues in the United States.** IUFRO V Meet. Proc. 1973, vol. 2. p. 911-917.

1898. Sarles, Raymond L.
1975. **New equipment for bark application.** For. Prod. Res. Soc. Tech. Options in Bark Util. Proc. P-73/74-11:7-24.

1899. Sarles, R. L., and E. vH. Larson.
1969. **High costs of improper seasoning.** Woodworking Dig. 71(7):34-35.

1900. Sartz, Richard S.
1966. **Rainfall distribution over dissected terrain in southwestern Wisconsin.** Water Resour. Res. 2:803-809.

1901. Sartz, Richard S., and Willie R. Curtis.
1967. **Simple sediment sampler for flumes.** Agric. Eng. 48:224.

1902. Saunders, Henry W.
1969. **Primary utilization of birch.** *In* Birch symp. proc. USDA For. Serv. Northeast. For. Exp. Stn. p. 33-37.

1903. Schemnitz, Sanford D.
1974. **Sweetfern.** *In* Shrubs and vines for northeastern wildlife. USDA For. Serv. Gen. Tech. Rep. NE-9. p. 138-139.

1904. Schmidt, J. W., Jr., W. D. Torlone, J. Bird, and M. R. Fedorko.
1970. **Feasibility study on the retrieval and use of primary wood residue.** W. Va. Univ. Eng. Exp. Stn. Rep. 11. 250 p.

1905. Schmidt, Robert A.
1966. **Temperature and atmospheric moisture regimes in the pine stump habitat of *Fomes annosus*** (Abstr.) Phytopathology 56:899.

1906. Schmitt, Daniel M.
1973. **Interspecific hybridization in forest trees: Potential not realized.** 14th Meet. Can. Tree Improv. Assoc. Proc. Part II. p. 57-66.

1907. Schopmeyer, C. S., and W. B. Leak.
1974. ***Ostrya Virginiana* (Mill.) K. Koch: Eastern hophornbeam.** *In* Seeds of woody plants in the United States. U.S. Dep. Agric., Agric. Handb. 450. p. 564-565.

1908. Schreiber, Lawrence R., and Leon S. Dochinger.
1967. **Fusarium canker on paper mulberry *(Broussonetia papyrifera).*** Plant Dis. Rep. 51:531-532.

1909. Schreiber, Lawrence R., and John W. Peacock.
1974. **Dutch elm disease and its control.** U.S. Dep. Agric., Agric. Inf. Bull. 193. 15 p.

1910. Schreiner, E. J.
1970. **Tree breeding in United States forestry practice.** Unasylva 24(97-98):96-108.

1911. Schreiner, E. J.
1972. **Genetic improvement of amenity trees.** Trees 32(6):112-114.

1912. Schreiner, Ernst J.
1966. **Future needs for maximum progress in genetic improvement of disease resistance in forest trees.** *In* Breeding pest-resistant trees. NATO and NSF Symp. Proc. p. 455-466.

1913. Schreiner, Ernst J.
1966. **Maximum genetic improvement of forest trees through synthetic multiclonal hybrid varieties.** 13th Northeast. For. Tree Improv. Conf. Proc. p. 7-13.

1914. Schreiner, Ernst J.
1967. **Guidelines for selecting and producing genetically better trees for street and park planting.** N.J. Fed. Shade Tree Comm. Annu. Meet. Proc., 1966. p. 38-43.

1915. Schreiner, Ernst J.
1967. **Origins, objectives, and membership of NEFTIC.** 14th Northeast. For. Tree Improv. Conf. Proc. p. 3.

1916. Schreiner, Ernst J.
1967. **Physiological and biochemical research on asexual reproduction in forest trees: An essential approach to early maximum genetic improvement.** 14th IUFRO Congr. Pap. 3 Sect. 22. p. 224-247.

1917. Schreiner, Ernst J.
1968. **Forest tree breeding.** Unasylva 22(3):3-9.

1918. Schreiner, Ernst J.
1968. **Mejoramiento genético de especies forestales.** Unasylva 22(3):3-9.

1919. Schreiner, Ernst J.
1968. **Sélection des essences forestières.** Unasylva 22(3):3-9.

1920. Schreiner, Ernst J.
1969. **Tree breeding in the United States forestry practice.** FAO and IUFRO 2nd World Consult. For. Tree Breeding Doc. F0-FTB-69-14/1. 29 p.

1921. Schreiner, Ernst J.
1970. **Mini-rotation forestry.** USDA For. Serv. Res. Pap. NE-174. 32 p.

1922. Schreiner, Ernst J.
1971. **Application of tree improvement of mini- midi- and maxi-rotation management.** 18th Northeast. For. Tree Improv. Conf. Proc. p. 39-48.

1923. Schreiner, Ernst J.
1971. **Genetics of eastern cottonwood.** USDA For. Serv. Res. Pap. WO-11. 19 p.

1924. Schreiner, Ernst J.
1972. **Mass production of improved forest tree planting stock through synthetic varieties.** *In* Biology of rust resistance in forest trees. NATO-IUFRO Adv. Stud. Inst. Proc. U.S. Dep. Agric. Misc. Publ. 1221. p. 571-590.

1925. Schreiner, Ernst J.
1972. **Procedure for selection of hybrid poplar clones for commercial trials in the Northeastern region.** 19th Northeast. For. Tree Improv. Conf. Proc. p. 108-116.

1926. Schreiner, Ernst J.
1972. **Tree breeding in United States forestry practice.** (In Japanese; transl. by Masaki Katsuta). J. Jap. For. Tree Breed. Assoc. 72:2-8.

1927. Schreiner, Ernst J.
1973. **Some aspects of NEFTIC in retrospect and prospect.** 20th Northeast. For. Tree Improv. Conf. Proc. p. 28-32.

1928. Schreiner, Ernst J.
1974. **Poplars can be bred to order for mini-rotation fiber, timber and veneer production and for amenity plantings.** 21st Northeast. For. Tree Improv. Conf. Proc. p. 85-96.

1929. Schreiner, Ernst J.
1974. ***Populus* L.: Poplar.** *In* Seeds of woody plants in the United States. U.S. Dep. Agric., Agric. Handb. 450. p. 645-655.

1930. Schrepter, Susan R., Edwin vH. Larson, and Elwood R. Maunder.
1973. **A history of the Northeastern Forest Experiment Station, 1923 to 1973.** USDA For. Serv. Gen. Tech. Rep. NE-7. 52 p.

1931. Schroeder, James G.
1968. **Lumber grade yields for subfactory class red oak logs.** USDA For. Serv. Res. Pap. NE-114. 15 p.

1932. Schroeder, James G., and Leland F. Hanks.
1967. **Lumber grade-yields for factory-grade northern red oak sawlogs.** USDA For. Serv. Res. Note NE-65. 7 p.

1933. Schuler, Albert T., and J. C. Meadows.
1975. **Planning resource use on National Forests to achieve multiple objectives.** J. Environ. Manage. 3:351-356.

1934. Schuster, Ervin G., and Thomas H. Pendleton.
1968. **Decisions on locating a new veneer plant.** South. Lumberman 217(2704):211-216.

1935. Scott, Eion G., and Bradford C. Bearce.

1972. **A hardwood-bark-sawdust compost for greenhouse pot flower production.** For. Prod. J. 22(1):36-39.

1936. Scott, Eion G., and Bradford C. Bearce.
1973. **Production of Cara Mia roses in various loamless composts.** Florists Rev. June 1973. p. 27,59-61.

1937. Seegrist, Donald W.
1973. **Least squares analysis of experimental design models by augmenting the data with side conditions.** Technometrics 15:643-645.

1938. Seegrist, Donald W.
1974. **Statistical models and estimators of the proportion of volume by log position.** For. Sci. 20:257-362.

1939. Seegrist, Donald W.
1974. **Weighted regression analysis and interval estimators.** USDA For. Serv. Res. Note NE-195. 5 p.

1940. Seegrist, Donald W.
1975. **A multivariate model and statistical method for validating tree grade lumber yield equations.** USDA For. Serv. Res. Pap. NE-320. 20 p.

1941. Seliga, T. A., and L. S. Dochinger.
1976. **First international symposium on acid precipitation and the forest ecosystem.** Int. J. Environ. Stud. 8(4):303-306.

1942. Seliskar, C.E.
1967. **Oak wilt *Ceratocystis fagacearum* (Bretz) Hunt.** *In* Important forest insects and diseases of mutual concern to Canada, the United States and Mexico. Can. Dep. For. and Rural Dev. Publ. 1180. p. 173-176.

1943. Seliskar, Carl E.
1966. **Virus and viruslike disorders of forest trees.** 1964 FAO/IUFRO Symp. Doc. Int. Dangerous For. Dis. Insects 4-5 (1,2,3):1-43.

1944. Seliskar, Carl E.
1973. **Association of a mycoplasmalike organism with walnut bunch disease.** 2nd Int. Congr. Plant Pathol. Abstr. 0933. 1 p.

1945. Seliskar, Carl E.
1973. **Review of "A textbook of plant virus diseases."** For. Sci. 19:189-190.

1946. Seliskar, Carl E.
1976. **Mycoplasmalike organism found in the phloem of bunch-diseased walnuts.** For. Sci. 22:144-148.

1947. Seliskar, Carl E., Glenn E. KenKnight, and Carol E. Bourne.
1974. **Mycoplasmalike organism associated with pecan bunch disease.** Phytopathology 64:1269-1272.

1948. Seliskar, Carl E., Charles L. Wilson, and Carol E. Bourne.
1973. **Mycoplasmalike bodies found in phloem of black locust affected with witches'-broom.** Phytopathology 63:30-34.

1949. Sendak, Paul E.
1972. **The effect of the tariff on the maple industry.** USDA For. Serv. Res. Note NE-148. 5 p.

1950. Sendak, Paul E.
1972. **The national pure maple syrup consumer survey.** Proc. 8th Conf. Maple Prod. ARS 73-73 (EMN Publ. 3618). p. 50-56.

1951. Sendak, Paul E.
1972. **Why the tariff failed.** Natl. Maple Syrup Dig. 11(12):18-23.

1952. Sendak, Paul E.
1973. **Wood pallet manufacturing costs in Pennsylvania.** For. Prod. J. 23(9):110-113.

1953. Sendak, Paul E.
1974. **Analysis of pure maple syrup consumers.** USDA For. Serv. Res. Pap. NE-295. 11 p.

1954. Sendak, Paul E.
1976. **Marketing and marketing research in the maple products industry.** Natl. Maple Syrup Dig. 15(1):16-17.

1955. Sendak, Paul E., and Mariafranca Morselli.
1974. **Control of fancy maple syrup quality in the retail package.** Natl. Maple Syrup Dig. 13(4):14-18.

1956. Shafer, E. L.
1969. **Deer-food quantity measurements: What method is best?** Northeast. Deer Study Group Trans. 3 p. 115-120.

1957. Shafer, Elwood L., Jr.
1967. **Forest aesthetics: A focal point**

in multiple-use management and research. 14th IUFRO Congr. Pap. 7 Sect. 26. p. 47-71.

1958. Shafer, Elwood L., Jr.
1968. **Recent recreation research implications from the physical and biological sciences.** Parks & Recreation, August. p. 22-24,51.

1959. Shafer, Elwood L., Jr.
1968. **Recent contributions to recreation research from related disciplines.** 1967 Congr. for Recreation and Parks. p. 109-111.

1960. Shafer, Elwood L., Jr.
1968. **Recent recreation research implications from the physical and biological sciences.** Parks & Recreation 3(8):22-24, 51-52.

1961. Shafer, Elwood L., Jr.
1968. **The demand for water-oriented outdoor recreation.** Parks & Recreation 3(2):22-24,57.

1962. Shafer, Elwood L., Jr.
1969. **The average camper who doesn't exist.** USDA For. Serv. Res. Pap. NE-142. 27 p.

1963. Shafer, Elwood L., Jr.
1969. **The name of the game is recreation research.** Rural Sociol. Suppl. Sociol. Abstr. Suppl. 4 (Part 2 of 4 parts). Abstr. D., 8886.

1964. Shafer, Elwood, Jr.
1969. **"Natural landscape preferences: A predictive model."** A reply. J. Leisure Res. 1:197-198.

1965. Shafer, Elwood L., Jr.
1969. **Perception of natural environments.** Environ. and Behav. 1(1):71-82.

1966. Shafer, Elwood L.
1969. **Recreation demand from wharf to waterfall.** Soc. Am. For. Annu. Meet. (1968). Abstr. Pap. 15.

1967. Shafer, Elwood L.
1969. **Recreation demand from wharf to waterfall.** Parks & Recreation 4(8):18-20, 56-57.

1968. Shafer, Elwood L., Jr.
1970. **The name of the game is recreation research.** Environ. Educ. 2(1):30-34.

1969. Shafer, Elwood L.
1971. **Surveys in recreation research.** Pa. Dep. Environ. Resour. For. Conf. Proc. p. 28-32.

1970. Shafer, Elwood L., Jr.
1972. **Aesthetic and emotional experiences rate high with Northeast wilderness hikers.** *In* Environment and the social sciences: Perspectives and applications. Am. Psychol. Assoc., Inc., Washington, D.C. p. 207-216. (Reprinted from Environ. and Behav. 1969:187-197.)

1971. Shafer, Elwood L., Jr.
1972. **Review of "Open land for urban America."** J. For. 70:640.

1972. Shafer, Elwood L., Jr.
1974. **The average camper who doesn't exist.** Land & Leisure: Concepts and methods in outdoor recreation. p. 112-129.

1973. Shafer, Elwood L., Jr.
1975. **The impact of human needs on the natural environments for recreation.** *In* Indicators of change in the recreational environment: A national symposium. Pa. State Univ. HPER Ser. 6. p. 328-334.

1974. Shafer, Elwood L., Jr., Paul H. Amidon, and C. W. Severinghaus.
1972. **A comparison of violators and non-violators of New York's deer-hunting laws.** J. Wildl. Manage. 36:933-939.

1975. Shafer, Elwood L., and Warren T. Doolittle.
1971. **The Pinchot Institute: "Breaking new ground" throughout megalopolis.** Soc. Am. For. 16 p.

1976. Shafer, Elwood L., and Warren T. Doolittle.
1972. **The Pinchot Institute: Breaking new ground throughout megalopolis.** Pa. For. 63(1):20-24.

1977. Shafer, Elwood L., Jr., and John F. Hamilton, Jr.
1967. **A comparison of four survey techniques used in outdoor recreation.** USDA For. Serv. Res. Pap. NE-86. 22 p.

1978. Shafer, Elwood, L., Jr., John F. Hamilton, Jr., and Elizabeth A. Schmidt. 1968. **Natural landscape preferences: A predictive model.** J. Leisure Res. 1:1-19.

1979. Shafer, Elwood L., Jr., John F. Hamilton, Jr., and Elizabeth A. Schmidt. 1970. **Natural landscape preferences: A predictive model.** Ekistics 29(173):278-283.

1980. Shafer, Elwood L., Jr., and Stephen A. Liscinsky. 1968. **Design and analysis for multiple-use studies of deer browse and timber production.** USDA For. Serv. Res. Pap. NE-100. 25 p.

1981. Shafer, Elwood L., Jr., and James Mietz. 1969. **Aesthetic and emotional experiences rate high with northeast wilderness hikers.** Environ. and Behav. 1(2):187-197.

1982. Shafer, Elwood L., Jr., and James Mietz. 1970. **It seems possible to quantify scenic beauty in photographs.** USDA For. Serv. Res. Pap. NE-162. 12 p.

1983. Shafer, Elwood L., Jr., and George Moeller. 1971. **Predicting quantitative and qualitative values of recreation participation.** *In* Recreation symp. proc. USDA For. Serv. Northeast. For. Exp. Stn. p. 5-22.

1984. Shafer, Elwood L., Jr., and George H. Moeller. 1974. **Through the looking glass...in environmental management.** Parks & Recreation 9(2):20-23,48-49.

1985. Shafer, Elwood L., and George H. Moeller. 1974. **Wildlife priorities and benefits: Now, 2000, and beyond.** *In* Transactions of the 39th North American wildlife and natural resources conference. Wildl. Manage. Inst. p. 208-215.

1986. Shafer, Elwood L., George H. Moeller, and Russell E. Getty. 1974. **Future leisure environments.** USDA For. Serv. Res. Pap. NE-301. 16 p.

1987. Shafer, Elwood L., George Moeller, Douglas A. Morrison, and Russell Getty. 1974. **Recreation, resources, and right decisions.** USDA For. Serv. Res. Pap. NE-293. 16 p.

1988. Shafer, Elwood L., Jr., and Douglas A. Morrison. 1973. **Changing attitudes among forestry students.** J. Environ. Educ. 4(4):44-47.

1989. Shafer, Elwood L., and Rita M. Rammrath. 1971. **Outdoor recreation use.** Trends 8(4):22-25.

1990. Shafer, Elwood L., Jr., and Thomas A. Richards. 1974. **A comparison of viewer reactions to outdoor scenes and photographs of those scenes.** USDA For. Serv. Res. Pap. NE-302. 26 p.

1991. [Shafer, Elwood L., Jr., and William Rutherford, Jr.] 1969. **Selection cuts increased natural beauty in two Adirondack forest stands.** J. For. 67:415-419.

1992. Shafer, Elwood L., Jr., and Roger C. Thompson. 1968. **Models that describe use intensity of Adirondack campgrounds.** For. Sci. 14-383-391.

1993. Shafer, Elwood L., and Michael Tooby. 1973. **Landscape preferences: An international replication.** J. Leisure Res. 5:60-65.

1994. Sharon, E. M. 1972. **Wounding induces a change in metabolic activity in cells of *Acer saccharum*.** *In* 2nd North American Forest biology workshop proc. p. 15-16.

1995. Sharon, E. M. 1974. **An altered pattern of enzyme activity in tissues associated with wounds in *Acer saccharum*.** Physiol. Plant Pathol. 4:307-312.

1996. Sharon, E. M. 1974. **Anaerobic environment enhances the detection of bacteria in tissues associated with wounds in living trees.** (Abstr.) Phytopathology 64:585.

1997. Sharon, Edward M.
1973. **Some histological features of *Acer saccharum* wood formed after wounding.** Can. J. For. Res. 3:83-89.

1998. Sharon, Edward M., and Alex L. Shigo.
1974. **A method for studying the relationship of wounding and microorganisms to the discoloration process in living trees.** Can. J. For. Res. 4:146-148.

1999. Sharp, Ward M.
1974. **Ecology of shrubs and vines.** *In* Shrubs and vines for northeastern wildlife. USDA For. Serv. Gen. Tech. Rep. NE-9. p. 2-5.

2000. Sharp, Ward M.
1974. **Hawthorns.** *In* Shrubs and vines for northeastern wildlife. USDA For. Serv. Gen. Tech. Rep. NE-9. p. 59-64.

2001. Shaw, Samuel P.
1969. **Management of birch for wildlife habitat.** *In* Birch symp. proc. USDA For. Serv. Northeast. For. Exp. Stn. p. 181-183.

2002. Shaw, Samuel P.
1971. **Wildlife and oak management.** *In* Oak symp. proc. USDA For. Serv. Northeast. For. Exp. Stn. p. 84-89.

2003. Shaw, Samuel P., and David A. Gansner.
1975. **Incentives to enhance timber and wildlife management on private forest lands.** *In* Transactions of the 40th North American wildlife and natural resources conference. Wildl. Manage. Inst. p. 177-185.

2004. Shields, Kathleen Stone.
1976. **The development of *Blepharipa pratensis* and its histopathological effects on the gypsy moth, *Lymantria dispar*.** Ann. Entomol. Soc. Am. 69:667-670.

2005. Shigo, Alex.
1969. **The death and decay of trees.** Nat. Hist. 78(3): 42-47.

2006. Shigo, Alex L.
1966. **Decay and discoloration following logging wounds on northern hardwoods.** USDA For. Serv. Res. Pap. NE-47. 43 p.

2007. Shigo, Alex L.
1966. **Defects in birch associated with injuries made by *Xyloterinus politus* Say.** USDA For. Serv. Res. Note NE-49. 7 p.

2008. Shigo, Alex L.
1966. **Organism interactions in decay and discoloration in beech, birch, and maple.** *In* Holz and Organismen, vol. 1. Duncker & Humblot, Berlin. p. 309-324.

2009. Shigo, Alex L.
1967. **The early stages of discoloration and decay in living hardwoods in northeastern United States: a consideration of wound-initiated discoloration and heartwood.** 14th IUFRO Congr. Pap. 9 Sect. 41. p. 118-133.

2010. Shigo, Alex L.
1967. **Successions of organisms in discoloration and decay of wood.** *In* International review of forestry research vol. 2. Academic Press, New York. p. 237-299.

2011. Shigo, Alex L.
1969. **Diseases of birch.** *In* Birch symp. proc. USDA For. Serv. Northeast. For. Exp. Stn. p. 147-150.

2012. Shigo, Alex L.
1969. **How *Poria obliqua* and *Polyporus glomeratus* incite cankers.** Phytopathology 59:1164-1165.

2013. Shigo, Alex L.
1970. **Beech bark disease.** USDA For. Serv. For. Pest Leafl. 75.(Rev.) 8 p.

2014. Shigo, Alex L.
1970. **An expanded concept of decay in living trees.** *In* Interaction of organisms in the process of decay of forest trees. Laval Univ. For. Res. Found. Bull. 15. p. 7-9.

2015. Shigo, Alex L.
1970. **Growth of *Polyporus glomeratus*, *poria obliqua*, *Fomes igniarius*, and *Pholiota squarrosa-adiposa* in media amended with manganese, calcium, zinc, and iron.** Mycologia 62:604-607.

2016. Shigo, Alex L.
1971. **The beech bark disease in northeastern United States.** IUFRO Congr. 15. 8 p.

2017. Shigo, Alex L.
1971. **The beech bark disease spreads southwords.** South. Lumberman 223(2776):83.

2018. Shigo, Alex L.
1971. **Discoloration and decay in oak.** *In* Oak symp. proc. USDA For. Serv. Northeast. For. Exp. Stn. p. 135-141.

2019. Shigo, Alex L.
1971. **Shakes associated with wounds in trees.** IUFRO Congr. 15. 5 p.

2020. Shigo, Alex L.
1971. **Successions of microorganisms and patterns of discoloration and decay after wounding in red oak and white oak.** (Abstr.) Phytopathology 61:910.

2021. Shigo, Alex L.
1971. **Successions of microorganisms and patterns of discoloration and decay following wounding in deciduous hardwoods.** 2nd Int. Symp. Plant Pathol. Proc. Indian Agric. Res. Inst., New Delhi. p. 175.

2022. Shigo, Alex L.
1972. **The beech bark disease today in the northeastern U.S.** J. For. 70:286-289.

2023. Shigo, Alex L.
1972. **In the beginning.** South. Lumberman 225(2800):168-169.

2024. Shigo, Alex L.
1972. **Review of "European Journal of Forest Pathology," Parey, Hamburg and Berlin.** Phytopathol. News 6(8):4.

2025. Shigo, Alex L.
1972. **Ring and ray shakes associated with wounds in trees.** Holzforschung 26(2):60-62.

2026. Shigo, Alex L.
1972. **Successions of microorganisms and patterns of discoloration and decay after wounding in red oak and white oak.** Phytopathology 62:256-259.

2027. Shigo, Alex L.
1972. **Wound dressing research on red maples.** Int. Shade Tree Conf. Proc. 47:97a-98a.

2028. Shigo, Alex L.
1973. **Biology of decay and wood quality.** 2nd Int. Cong. Plant Pathol. Abstr. 0565. 1 p.

2029. Shigo, Alex L.
1973. **Insect and disease control: Forest fertilization relations.** *In* Forest fertilization symp. proc. USDA For. Serv. Gen. Tech. Rep. NE-3. p. 117-121.

2030. Shigo, Alex L.
1974. **Effects of manganese, calcium, zinc, and iron on growth and pigmentation of** *Trichocladium canadense, Phialophora melinii, Hypoxylon rubiginosum, Daldinia concentrica,* **and** *Cytospora decipiens.* Mycologia 66:339-341.

2031. Shigo, Alex L.
1974. **A new look at decay in trees.** North. Logger 23(4):10-11, 38-39.

2032. Shigo, Alex L.
1974. **Relative abilities of** *Phialophora melinii, Fomes connatus,* **and** *F. igniarius* **to invade freshly wounded tissues of** *Acer rubrum.* Phytopathology 64:708-710.

2033. Shigo, Alex L.
1975. **Biology of decay and wood quality.** *In* Biological transformation of wood by microorganisms. 2nd Int. Congr. Plant Pathol. Proc. Sess. Wood Prod. Springer-Verlag, New York. [15 p.]

2034. Shigo, Alex L.
1975. **Compartmentalization of decay associated with** *Fomes annosus* **in trunks of** *Pinus resinosa.* Phytopathology 65:1038-1039.

2035. Shigo, Alex L.
1975. **Heartwood and discolored wood.** North. Logger 25(2):28-29.

2036. Shigo, Alex L.
1975. **A new look at decay in trees.** *In* Proc. New Horiz. Day. Hortic. Res. Inst. July 23, 1975, Chicago, Ill. p. 10-12. (Repr. North. Logger 1974 23(4):10-11,38-39.)

2037. Shigo, Alex L.
1975. **Wood decay.** *In* McGraw-Hill yearbook of science & technology. McGraw-Hill Book Co., New York. p. 417-419.

2038. Shigo, Alex L.
1976. **Communication of knowledge and needs between researcher and arboriculturist.** J. Arboric. 2(11): 206-208.

2039. Shigo, Alex L.
1976. **Compartmentalization of discolored and decayed wood in trees.** Mater. Org. 3:221-226.

2040. Shigo, Alex L.
1976. **Microorganisms isolated from wounds inflicted on red maple, paper birch, American beech, and red oak in winter, summer, and autumn.** Phytopathology 66:599-663.

2041. Shigo, Alex L.
1976. **Mineral stain.** North. Logger 24(8):18-19.

2042. Shigo, Alex L., and Paul Berry.
1975. **A new tool for detecting decay associated with *Fomes annosus* in *Pinus resinosa.*** Plant Dis. Rep. 59:739-742.

2043. Shigo, Alex L., and David Carroll.
1975. **What's the name of that tree?** Reader's Dig. 107(641):155-162.

2044. Shigo, Alex L., and W. E. Hillis.
1973. **Heartwood, discolored wood, and microorganisms in living trees.** Annu. Rev. Phytopathol. 11:197-222.

2045. Shigo, Alex L., and Lawrence Kilham.
1968. **Sapsuckers and *Fomes igniarius* var. *Populinis.*** USDA For. Serv. Res. Note NE-84. 2 p.

2046. Shigo, Alex L., and Frederick M. Laing.
1970. **Some effects of paraformaldehyde on wood surrounding tapholes in sugar maple trees.** USDA For. Serv. Res. Pap. NE-161. 11 p.

2047. Shigo, Alex L., and Edwin vH. Larson.
1969. **A photo guide to the patterns of discoloration and decay in living northern hardwood trees.** USDA For. Serv. Res. Pap. NE-127. 100 p.

2048. Shigo, Alex L., and Edwin vH. Larson.
1975. **Anatomy of a wound.** Weeds, Trees and Turf 14(7):20-22.

2049. Shigo, Alex L., William B. Leak, and Stanley M. Filip.
1973. **Sugar-maple borer injury in four hardwood stands in New Hampshire.** Can. J. For. Res. 3:512-515.

2050. Shigo, Alex L., and Edward M. Sharon.
1968. **Discoloration and decay in hardwoods following inoculations with hymenomycetes.** Phytopathology 58: 1493-1498.

2051. Shigo, Alex L., and Edward M. Sharon.
1968. **Mapping columns of discolored and decayed wood in sugar maple.** (Abstr.) Phytopathology 58:1067.

2052. Shigo, Alex L., and Edward M. Sharon.
1970. **Mapping columns of discolored and decayed tissues in sugar maple, *Acer saccharum.*** Phytopathology 60:232-237.

2053. Shigo, Alex L., Edward M. Sharon, and Robert W. Brandt.
1966. **Discoloration and decay following inoculations of northern hardwoods with hymenomycetes.** (Abstr.) Phytopathology 56:900-901.

2054. Shigo, Alex L., and Alex Shigo.
1974. **Detection of discoloration and decay in living trees and utility poles.** USDA For. Serv. Res. Pap. NE-294. 11 p.

2055. Shigo, Alex L., Joseph Stankewich, and Benjamin J. Cosenza.
1971. **Clostridium sp. associated with discolored tissues in living oaks.** Phytopathology 61:122-123.

2056. Shigo, A. L., and G. L. Stone.
1967. **Beech bark disease *Nectria coccinea* Pers. ex Fr. var. *faginata* Lohm., Wats., and Ayers.** *In* Important forest insects and diseases of mutual concern to Canada, the United States and Mexico. Can. Dep. For. and Rural Dev. Publ. 1180. p. 195-198.

2057. Shigo, A. L., and R. S. Walters.
1972. **Decay associated with paraformaldehyde-treated tapholes in sugar maple.** Phytopathology 62:789.

2058. Shigo, Alex L., and Charles L. Wilson.
1971. **Are tree wound dressings beneficial?** Arborists' News 36:85-88.

2059. Shigo, Alex L., and Charles L. Wilson. 1972. **Discoloration associated with wounds one year after application of wound dressings.** Arborists' News 37:121-124.

2060. Shiner, James William, and Elwood L. Shafer, Jr.
1975. **How long do people look at and listen to forest-oriented exhibits?** USDA For. Serv. Res. Pap. NE-325. 16 p.

2061. Shortle, W. C., and E. B. Cowling.
1976. **Development of discoloration, microorganisms, and decay in living sweetgum and yellow-poplar trees.** Mater. Org. 3:213-220.

2062. Shortle, Walter C., and Alex L. Shigo.
1973. **Concentrations of manganese and microorganisms in discolored and decayed wood in sugar maple.** Can. J. For. Res. 3:354-358.

2063. Shottafor, J. E.
1968. **Potential production: Plywood from eastern spruce.** For. Prod. J. 18(10):18-21.

2064. Shull, Kenneth E.
1975. **Meeting current and future drinking-water quality standards.** *In* Municipal watershed management symp. proc. USDA For. Serv. Gen. Tech. Rep. NE-13. p. 142-153.

2065. Shutts, Lynn M.
1974. **Summer grape.** *In* Shrubs and vines for northeastern wildlife. USDA For. Serv. Gen. Tech. Rep. NE-9. p. 52-53.

2066. Skutt, H. Richard, Alex L. Shigo, and Ronald A. Lessard.
1972. **Detection of discolored and decayed wood in living trees using a pulsed electric current.** Can. J. For. Res. 2:54-55.

2067. Smith, H. Clay.
1966. **Epicormic branching on eight species of Appalachian hardwoods.** USDA For. Serv. Res. Note NE-53. 4 p.

2068. Smith, H. Clay.
1967. **Visible dormant buds as related to tree diameter and log position.** USDA For. Serv. Res. Note NE-56. 4 p.

2069. Smith, H. Clay.
1968. **Bark thickness: Is it important?** Natl. Maple Syrup Dig. 7(3):19.

2070. Smith, H. Clay.
1969. **Bark thickness related to tree diameter in sugar maple** *(Acer saccharum* Marsh.) USDA For. Serv. Res. Note NE-107. 4 p.

2071. Smith, H. Clay.
1969. **Use either aerial line or ground line tubing with vented spouts.** Natl. Maple Syrup Dig. 8(2):6-7.

2072. Smith, H. Clay.
1971. **Sap volume flow as influenced by tubing diameter and slope percent.** USDA For. Serv. Res. Note NE-137. 6 p.

2073. Smith, H. Clay.
1971. **Tapping near old tapholes in sugar maple trees.** USDA For. Serv. Res. Note NE-126. 3 p.

2074. Smith, H. Clay, and Carter B. Gibbs. 1970. **Are pellets necessary with vacuum-pumping?** Natl. Maple Syrup Dig. 9(3):14-15.

2075. Smith, M. Clay, and Carter B. Gibbs. 1970. **Comparison of vacuum and gravity sap flows from paired sugar maple trees.** USDA For. Serv. Res. Note NE-122. 4 p.

2076. Smith, H. Clay, and Carter B. Gibbs. 1970. **A guide to sugarbush stocking based on the crown diameter/d.b.h. realationship of open-grown sugar maples.** USDA For. Serv. Res. Pap. NE-171. 8 p.

2077. Smith, H. Clay, and Carter B. Gibbs. 1970. **Paraformaldehyde pellet not necessary in vacuum-pumped maple sap system.** USDA For. Serv. Res. Note NE-118. 4 p.

2078. Smith, H. Clay, and Carter B. Gibbs. 1971. **Collecting maple sap with unvented spouts, using aerial and ground lines.** USDA For. Serv. Res. Note NE-130. 4 p.

2079. Smith, H. Clay, and Carter B. Gibbs. 1971. **How many trees?** Natl. Maple Syrup Dig. 10(2):5-7.

2080. Smith, H. Clay, and George M. Keiser. 1971. **Tapping speed and sugar maple sap yields.** Natl. Maple Syrup Dig. 9(3):14-15.

2081. Smith, H. Clay, and George M. Keiser. 1971. **Testing sugar maple sap for sweetness with a refractometer.** USDA For. Serv. Res. Note NE-138. 4 p.

2082. Smith, H. Clay, and Richard J. Lamore. 1971. **Speed of tapping does not influence maple sap yields.** USDA For. Serv. Res. Note NE-132. 4 p.

2083. Smith, H. Clay, and N. I. Lamson. 1975. **Grapevines in 12- to 15-year-old even-aged Central Appalachian hardwood stands.** Proc. 3rd Annu. Hardwood Symp. Hardwood Res. Counc. p. 145-150.

2084. Smith, H. Clay, Robert L. Rosier, and K. P. Hammack. 1976. **Reproduction 12 years after seed-tree harvest cutting in Appalachian hardwoods.** USDA For. Serv. Res. Pap. NE-350. 11 p.

2085. Smith, H. Clay, and Arthur H. Rye. 1970. **Measure that vacuum.** Natl. Maple Syrup Dig. 9(2):12-13.

2086. Smith, H. Clay, and Paul M. Smithson. 1975. **Cost of cutting grapevines before logging.** USDA For. Serv. Res. Note NE-207. 4 p.

2087. Smith, H. Clay, and Albert G. Snow, Jr. 1971. **Maple sugaring with vacuum pumping during the fall season.** USDA For. Serv. Res. Note NE-134. 5 p.

2088. Smith, H. Clay, and Albert G. Snow, Jr. 1972. **Installing plastic tubing to collect sugar maple sap.** USDA For. Serv. Res. Pap. NE-240. 16 p.

2089. Smith, H. C., and A. G. Snow, Jr. 1972. **Pumping during the fall season.** Natl. Maple Syrup Dig. 11(2):10-11.

2090. Smith, H. Clay, and Albert G. Snow, Jr. [1973]. **La mise en place d'une tuyauterie de plastique pour la cueillette de la sève d'érable.** (French transl. Res. Pap. NE-240.) William T. H. Nicholson, Lake Catherine, St. Emile de Montcalm, Quebec, Canada. 16 p.

2091. Smith, H. Clay, and George R. Trimble, Jr. 1970. **Mistblowing a hardwood understory in West Virginia with "D-T" herbicide.** USDA For. Serv. Res. Note NE-115. 6 p.

2092. Smith, H. Clay, E. Bradford Walker, Alex L. Shigo, and Frederick M. Laing. 1970. **Results of recent research on the pellet.** Natl. Maple Syrup Dig. 9(4):18-21.

2093. Smith, H. Clay, and Russell S. Walters. 1971. **Aerial line or ground line?** Natl. Maple Syrup Dig. 10(4):10-11.

2094. Smith, H. Clay, and Russell S. Walters. 1972. **How close can you tap to an old taphole?** Natl. Maple Syrup Dig. 11(1):14-15.

2095. Smith, Hanley K. 1974. **Sumacs.** *In* Shrubs and vines for northeastern wildlife. USDA For. Serv. Gen. Tech. Rep. NE-9. p. 134-137.

2096. Smith, Harvey R. 1975. **Management of *Peromyscus leucopus* as a part of an integrated program to control the gypsy moth.** *In* Northeastern wildlife conference proc. New Haven, Conn. p. 111-129.

2097. Smith, Harvey R., and Peter A. Jordan. 1976. **An exploited population of muskrats with unusual biomass, productivity, and body size.** Conn. Dep. Environ. Prot., State Geol. and Nat. Hist. Surv. Rep. Invest. 7. 16 p.

2098. Smith, James L., and Howard G. Halverson. 1976. **Forest ecology.** *In* McGraw-Hill yearbook of science & technology. McGraw-Hill Book Co., New York. p. 187-189.

2099. Smith, Joseph H., and James H. Patric. 1976. **Skyline cable logging.** Wonderful W. Va. 40(9):23-24.

2100. Smith, Robert L.
1974. **Greenbriers.** *In* Shrubs and vines for northeastern wildlife. USDA For. Serv. Gen. Tech. Rep. NE-9. p. 54-58.

2101. Smith, W. H., and L. S. Dochinger.
1976. **Evaluation and ranking of research priorities.** *In* Air pollution and metropolitan woody vegetation. USDA For. Serv. Pinchot Inst. Environ. For. Stud. p. 53-54.

2102. Smith, William H., and Leon S. Dochinger.
1976. **Capability of metropolitan trees to reduce atmospheric contaminants.** *In* Better trees for metropolitan landscapes symp. proc. USDA For. Serv. Gen. Tech. Rep. NE-22. p. 49-59.

2103. Smithberg, Margaret.
1974. **Red-osier dogwood.** *In* Shrubs and vines for northeastern wildlife. USDA For. Serv. Gen. Tech. Rep. NE-9. p. 44-47.

2104. Smithberg, Margaret, and John D. Gill.
1974. **Roses.** *In* Shrubs and vines for northeastern wildlife. USDA For. Serv. Gen. Tech. Rep. NE-9. p. 116-121.

2105. Smithson, Paul, and Ross A. Phillips.
1970. **Skidroads for logging operations in the Appalachians.** Proc. For. Eng. Workshop on For. Roads. W. Va. Univ. 71(1-4):17-23.

2106. Snow, Albert G., Jr.
1968. **Our sugar maple resource: Report on the Houghton sugar maple conference.** Proc. 7th Conf. Maple Prod., p. 15-16.

2107. Snow, Albert G., Jr.
1969. **Our sugar maple resource.** Natl. Maple Syrup Dig. 8(1):20-22.

2108. Snow, Albert G., Jr.
1970. **Maple sugaring in Connecticut for profit and pleasure.** Natl. Maple Syrup Dig. 9(1):16-18.

2109. Snow, Albert G., Jr., and Carter B. Gibbs.
1969. **Milking sugar maple trees for more sap.** South. Lumberman 219(2728):161-162.

2110. Solomon, Dale S.
1968. **Applying site-index curves to northern hardwoods in New Hampshire.** USDA For. Serv. Res. Note NE-79. 5 p.

2111. Solomon, Dale S.
1974. **Simulation of the development of natural and silviculturally treated stands of even-aged northern hardwoods.** *In* Growth models for tree and stand simulation. IUFRO Work Party Proc. S4.01-4. Swed. R. Coll. For. Res. Note 30, Stockholm. p. 327-352.

2112. Solomon, Dale S.
1975. **A test of point-sampling in northern hardwoods.** USDA For. Serv. Res. Note NE-215. 2 p.

2113. Solomon, Dale S., and Barton M. Blum.
1967, **Stump sprouting of four northern hardwoods.** USDA For. Serv. Res. Pap. NE-59. 13 p.

2114. Solomon, Dale S., and William B. Leak.
1969. **Stocking, growth, and yield of birch stands.** *In* Birch symp. proc. USDA For. Serv. Northeast. For. Exp. Stn. p. 106-118.

2115. Solomon, Dale S., and Richard J. Nolet.
1968. **Reliability of tree-height measurements in northern hardwood stands.** USDA For. Serv. Res. Note NE-86. 3 p.

2116. Solomon, Dale S., and Alex L. Shigo.
1976. **Discoloration and decay associated with pruning wounds on yellow birch.** For. Sci. 22:391-392.

2117. Solomon, J.C., and C.J. Hay.
1974. **Annotated bibliography of the carpenterworm** *(Prionoxytus robiniae).* USDA For. Serv. Gen. Tech. Rep. SO-4. 13 p.

2118. Sonderman, David L.
1970. **Balsam fir** *(Abies balsamea).* U.S. Dep. Agric. For. Serv. Am. Woods Ser. FS-234. 8 p.

2119. Sonderman, David L.
1974. **A simple and inexpensive pulsing device for data-recording cameras.** USDA For. Serv. Res. Note NE-183. 4 p.

2120. Sopper, W. E., and L. T. Kardos. 1973. **Vegetation responses to irrigation with treated municipal wastewater.** *In* Recycling treated municipal wastewater and sludge through forest and cropland. Pa. State Univ. Press. University Park. p. 271-294.

2121. Sopper, William E., and Louis T. Kardos, eds. 1973. **Recycling treated municipal wastewater and sludge through forest and cropland.** Pa. State Univ. Press, University Park. 479 p.

2122. Sopper, William E., and Howard W. Lull. 1967. **An evaluation of streamflow timing from small watersheds in Northeastern United States.** 14th IUFRO Congr. Sect. 11. p. 281-297.

2123. Sopper, William E., and Howard W. Lull, eds. 1967. **International symposium on forest hydrology.** Pergamon Press, Oxford, England. 813 p.

2124. Sopper, William E., and Howard W. Lull. 1970. **Streamflow characteristics of the Northeastern United States.** Pa. State Univ. Agric. Exp. Stn. Bull. 766. 129 p.

2125. Sopper, W. E., I. C. Reigner, and R. R. Johnson. 1966. **Effect of phenoxy herbicides on riparian vegetation and water quality.** Weeds, Trees and Turf 5(1):8-10.

2126. Sowa, Edward A., and Walter H. Davidson. 1976. **A new cover crop for spoil banks.** Pa. Farmer 194(1):132-133.

2127. Spencer, Bruce A. 1975. **Current management practices on metropolitan Boston's municipal watersheds.** *In* Municipal watershed management symp. proc. USDA For. Serv. Gen. Tech. Rep. NE-13. p. 105-110.

2128. Spomer, L. Art. 1974. **How much hardwood bark is necessary for proper container-soil amendment?** For. Prod. J. 25(2):57-59.

2129. Spomer, L. Art. 1975. **Availability of water absorbed by hardwood bark soil amendment.** Agron. J. 67:589-590.

2130. Spomer, L. Arthur. 1973. **Construction of welded "wet-loop" thermocouple psychrometer junctions.** Agron. J. 65(3):60-61.

2131. Spomer, L. Arthur 1973. **Soils in plant containers: Soil amendment, air, and water relationships.** Ill. Res. 15(3):16-17.

2132. Stairs, Gordon R. 1971. **Pathogens.** *In* Toward integrated control. Proc. 3rd Annu. Northeast. For. Insect Work Conf. USDA For. Serv. Res. Pap. NE-194 p. 45-58.

2133. Staley, D. H., W. N. Cannon, Jr., and W. R. Holt. 1971. **A mathematical model of an insect population with overlapping generations where the females are polyandrous and the males are subject to auto-sterilization.** Ann. Entomol. Soc. Am. 64:325-330.

2134. Staley, David H., William R. Holt, and William N. Cannon, Jr. 1974. **Necessary and sufficient condition for a model insect population to go to extinction.** Math. Biol. Bull. 36:527-533.

2135. Stankewich, Joseph P., Benjamin J. Cosenza, and Alex L. Shigo. 1971. *Clostridium quercicolum* **sp. n., isolated from discolored tissues in living oak trees.** Antonie van Leeuwenhoek J. Microbiol. Serol. 37:299-302.

2136. Stark, R. W. 1971. **Integrated control, pest management, or protective population management.** *In* Toward integrated control. Proc. 3rd Annu. Northeast. For. Insect Work Conf. USDA For. Serv. Res. Pap. NE-194. p. 111-129.

2137. Stearns, Forest W. 1974. **Hazels.** *In* Shrubs and vines for northeastern wildlife. USDA For. Serv. Gen. Tech. Rep. NE-9. p. 65-70.

2138. Steiner, Kim C., Henry D. Gerhold.
1976. **Testing and evaluating new trees for metropolitan landscapes.** *In* Better trees for metropolitan landscapes symp. proc. USDA For. Serv. Gen. Tech. Rep. NE-22. p. 227-234.

2139. Steinhagen, Hans-Peter.
1974. **Effect of kiln air velocity, at various moisture content levels, on drying rate of 4/4 yellow-poplar sapwood.** For. Prod. J. 24(4):45-47.

2140. Stern, E. G.
1972. **Southern pine pallets assembled with stiff stock and hardened steel pallet nails.** Va. Polytech. Inst. Res. Bull. 106. 12 p.

2141. Stern, E. G.
1973. **Douglas-fir lumber pallets assembled with stiff-wood and hardened-steel pallet nails.** Va. Polytech. Inst. and State Univ. Wood Res. and Wood Constr. Lab. Bull. 120. 12 p.

2142. Stern, E. G.
1973. **Reconfirmation of MIBANT test criteria for pallet nails.** Va. Polytech. Inst. and State Univ. Wood Res. and Wood Constr. Lab. Bull. 122. 11 p.

2143. Stern, E. G.
1974. **Design of pallet deckboard-stringer joints. Part 1: Aspen-pallet joints and aspen pallets.** Va. Polytech. Inst. and State Univ. Wood Res. and Wood Constr. Lab., Pallet and Container Res. Cent. Bull. 126. 48 p.

2144. Stern, E. G.
1974. **Recent pallet fastening research can reduce pallet costs.** Va. Polytech. Inst. and State Univ. Wood Res. and Wood Constr. Lab., Pallet and Container Res. Cent. Bull. 128. 8 p.

2145. Stern, E. George.
1968. **Laboratory evaluation of 48″ by 40″ hardwood lumber pallets.** Va. Polytech. Inst. Res. Div. Wood Res. and Wood Constr. Lab. Misc. Bull. 69. 12 p.

2146. Stern, E. George.
1968. **Laboratory evaluation of 48″ by 40″ oak pallets.** Va. Polytech. Inst. Res. Div. Wood Res. and Wood Constr. Lab. Misc. Bull. 70. 8 p.

2147. Stern, E. George.
1968. **Nailed 48″ by 40″ Douglas-fir lumber and plywood pallets.** Va. Polytech. Inst. Res. Div. Wood Res. and Wood Constr. Lab. Misc. Bull. 68. 24 p.

2148. Stern, E. George.
1968. **Nailed 48″ by 40″ picture-frame plywood-deck pallets.** Va. Polytech. Inst. Res. Div. Wood Res. and Wood Constr. Lab. Misc. Bull. 67. 20 p.

2149. Stern, E. George.
1969. **Rigidity of 48″ by 40″ Douglas-fir lumber and plywood pallets.** Va. Polytech. Inst. Res. Div. Wood Res. and Wood Constr. Lab. Misc. Bull. 84. 15 p.

2150. Stern, E. George.
1969. **Rigidity of 48″ by 40″ lumber pallets.** Va. Polytech. Inst. Res. Div. Wood Res. and Wood Constr. Lab. Misc. Bull. 78. 15 p.

2151. Stern, E. George.
1969. **Rigidity of 48″ by 40″ lumber pallets.** Part II. Va. Polytech. Inst. Res. Div. Wood Res. and Wood Constr. Lab. Misc. Bull. 79. 15 p.

2152. Stern, E. George.
1969. **Rigidity of 48″ by 40″ plywood and lumber-mat pallets.** Va. Polytech. Inst. Res. Div. Wood Res. and Wood Constr. Lab. Misc. Bull. 81. 15 p.

2153. Stern, E. George.
1969. **Up-grading of pallets by assembly with hardened-steel nails.** Va. Polytech. Inst. Res. Div. Wood Res. and Wood Constr. Lab. Misc. Bull. 83. 31 p.

2154. Stern, E. George.
1970. **Rigidity of nailed 48″ x 40″ plywood-deck pallets.** Va. Polytech. Inst. Res. Div. Wood Res. and Wood Constr. Lab. Misc. Bull. 90. 12 p.

2155. Stern, E. George.
1973. **Opportunities for Virginia's pallet industry.** Va. Polytech. Inst. and State Univ. Wood Res. and Wood Constr. Lab. Bull. 121. 48 p.

2156. Stern, E. George.
1975. **Design of pallet deckboard-stringer joints. Part II. Reinforced aspen pallet joints and aspen pallets.** Va. Polytech. Inst. and State Univ. Wood Res. and Wood Constr. Lab., Pallet and Container Res. Cent. Publ. 133. 24 p.

2157. Stern, E. George.
1975. **Aspen pallets with 2-1/4", 2-1/2", and 2-3/4" wide stringers and aspen pallets with oak stringers and leading-edge deckboards.** Va. Polytech. Inst. and State Univ. Wood Res. and Wood Constr. Lab., Pallet and Container Res. Cent. Publ. 135. 32 p.

2158. Stern, E. George.
1976. **Performance of pallet nails and staples in 22 southern hardwoods.** Va. Polytech. Inst. and State Univ. Wood Res. and Wood Constr. Lab., Pallet and Container Res. Cent. Publ. 145. 20 p.

2159. Stern, E. George, and William C. Miller.
1970. **Smaller tongue for strip flooring.** Va. Polytech. Inst. Res. Div. Wood Res. and Wood Constr. Lab. Misc. Bull. 89. 12 p.

2160. Stern, E. George, and William C. Miller.
1970. **Smaller tongue for strip flooring.** Flooring Mag. 76(8):61-63.

2161. Stern, E. George, and Walter B. Wallin.
1968. **Report on laboratory testing of PEP pallets.** Va. Polytech. Inst. Res. Div. Wood Res. and Wood Constr. Lab. Misc. Bull. 71. 15 p.

2162. Stern, E. George, and Walter B. Wallin.
1974. **How pallets stand.** Purch. World 18(9):68.

2163. Stern, E. George, and Walter B. Wallin.
1975. **Design of aspen pallet deckboard-stringer joints.** For. Prod. J. 25(2):51-54.

2164. Stern, E. George, and Walter B. Wallin.
1976. **Comparative performance of southern pine pallets.** Va. Polytech. Inst. and State Univ. Wood Res. and Wood Constr. Lab., Pallet and Container Res. Cent. Publ. 141. 36 p.

2165. Stipes, R. J.
1975. **Chemical control of *Ceratocystis ulmi:* An overview.** *In* Dutch elm disease. USDA For. Serv. Northeast. For. Exp. Stn. p. 1-15.

2166. Stone, Earl L.
1973. **Regional objectives in forest fertilization: current and potential.** *In* Forest fertilization symp. proc. USDA For. Serv. Gen. Tech. Rep. NE-3. p. 10-18.

2167. Storey, Herbert C., and Irvin C. Reigner.
1967. **Forests: National supplies and demands for water.** *In* Resources, foresters, and policies for progress. Proc. Soc. Am. For. 1966. p. 143-146.

2168. Stratton, K. G., L. O. Safford, and R. A. Struchtemeyer.
1968. **Two fertilizer studies with white pine in Maine.** Res. Life Sci. Summer: 1-6.

2169. Striffler, W. David.
1967. **Restoration of open-cast coal sites in Great Britain.** J. Soil & Water Conserv. 22:101-103.

2170. Striffler, David W.
1973. **Surface mining disturbance and water quality in eastern Kentucky.** *In* Ecology and reclamation of devastated land, vol. I. Gordon & Breach, New York. p. 175-190.

2171. Striffler, W. David, and Robert F. May.
1966. **Forest restoration of strip-mined areas.** *In* Forest resource decisions in a changing power structure. Proc. Soc. Am. For. 1965. p. 105-108.

2172. Strobel, John J., and Walter B. Wallin.
1969. **The unit-load explosion in the food industry.** USDA For. Serv. Res. Pap. NE-121. 60 p.

2173. Strobel, John J., and Walter B. Wallin.
1970. **The status of frozen food distribution today and where opportunities lie for economies.** Frozen Food Age 18(12):44-48, 51-55.

2174. Stuart, Gordon, and William M. Alden.
1975. **Current management practices on National forest watersheds: White Mountain National Forest.** *In* Municipal watershed management symp. proc. USDA For. Serv. Gen. Tech. Rep. NE-13. p. 129-134.

2175. Stutzbach, Stephen J., Albert L. Leaf, and Raymond E. Leonard.
1972. **Variation in forest floor under a red pine plantation.** Soil Sci. 114:24-28.

2176. Swett, Charles E.
1973. **An inexpensive mist system for plant propagation.** Tree Plant. Notes 24(2):4-5.

2177. Swingle, R. U., and R. R. Whitten.
1967. **Dutch elm disease *Ceratocystis ulmi* (Buism.) C. Moreau.** *In* Important forest insects and diseases of mutual concern to Canada, the United States and Mexico. Can. Dep. For. Rural Dev. Publ. 1180. p. 177-180.

2178. Tabor, Christopher A.
1974. **Review of "The life history of Douglas-fir," by George S. Allen and John N. Owens (1972).** For. Sci. 20:104.

2179. Tabor, Christopher A.
1974. **Review of "Organogenesis of flowers: A photographic text-atlas," by Rolf Sattler (1973).** For. Sci. 20:56.

2180. Tabor, D. W., and J. E. Shottafor.
1969. **The market potential for eastern spruce plywood.** Univ. Maine Sch. For. Resour. Bull. 674. 39 p.

2181. Talerico, Robert L.
1968. **Life history of the looper *Phigalia titea* in Virginia.** Ann. Entomol. Soc. Am. 61:557-561.

2182. Talerico, Robert L.
1971. **Fall cankerworm egg-mass studies.** J. Econ. Entomol. 64:763-764.

2183. Talerico, Robert L., and Roger C. Chapman.
1970. **Sequan: A computer program for sequential analysis.** USDA For. Serv. Res. Note NE-116. 6 p.

2184. Talerico, Robert L., Charles W. McComb, and Wallace T. Garrett.
1967. **Fiorinia externa Ferris, a scale insect of hemlock.** USDA For. Serv., For. Pest Leafl. 107. 4 p.

2185. Talerico, Robert L., and Thomas A. Skratt.
1973. **An application of a microvideo system to entomology.** J. Econ. Entomol. 66:816-817.

2186. Talerico, R. L. and T. A. Skratt.
1974. **Gypsy moth defoliation: Can we segregate damage levels from aerial photographs?** Univ. Maine and Am. Soc. Photogramm. 4th Bienn. Workshop Color Aer. Photogr. Proc. 1973. p. 233-234.

2187. Talerico, Robert L., and Robert W. Wilson, Jr.
1973. **Sampling plantations to determine white-pine weevil injury.** USDA For. Serv. Res. Note NE-173. 4 p.

2188. Tanner, C. B., C. A. Federer, T. A. Black, and J. B. Swan.
1969. **Economical radiometer: Theory, performance and construction.** Univ. Wis. Coll. Agric. and Life Sci. Res. Rep. 40. 86 p.

2189. Tattar, T. A., and A. L. Shigo.
1972. **Relationship between the degree of resistance to a pulsed electric current and wood in progressive stages of discoloration and decay in living trees.** Phytopathology 62:792.

2190. Tattar, Terry A., Alex L. Shigo, and Thomas Chase.
1972. **Relationship between the degree of resistance to a pulsed electric current and wood in progressive stages of discoloration and decay in living trees.** Can. J. For. Res. 2:236-243.

2191. Thirgood, J. V.
1971. **The historical significance of oak.** *In* Oak symp. proc. USDA For. Serv. Northeast. For. Exp. Stn. p. 1-18.

2192. Thomas, Jack Ward, Robert O. Brush, and Richard M. DeGraaf.
1973. **Invite wildlife to your backyard.** Natl. Wildl. 11(3):5-16.

2193. Thomas, Jack Ward, and Richard M. DeGraaf.
1973. **Non-game wildlife research in megalopolis: The Forest Service Program.** USDA For. Serv. Gen. Tech. Rep. NE-4. 12 p.

2194. Thomas, Jack Ward, and Richard M. DeGraaf.
1974. **Raccoons on the roof.** *In* Gardening with wildlife. Natl. Wildl. Fed. Washington, D.C. p. 153-168.

2195. Thomas, Jack Ward, Richard M. DeGraaf, and Joseph C. Mawson.
1974. **A technique for evaluating bird habitat.** *In* Wildlife in an urbanizing environment. Univ. Mass. Holdsworth Nat. Resour. Cent. Plann. and Dev. Ser. 28. p. 159-162.

2196 Thomas, Jack Ward, and Ronald A. Dixon.
1973. **Cemetery ecology.** Cathol. Cemetery 13(10):20-25.

2197. Thomas, Jack Ward, and Ronald A. Dixon.
1973. **Cemetery ecology.** Nat. Hist. 82:60-67.

2198. Thomas, Jack Ward, and Ronald A. Dixon.
1974. **Cemetery ecology.** *In* Wildlife in an urbanizing environment. Univ. Mass. Holdsworth Nat. Resour. Cent. Plann. and Dev. Ser. 28 p. 107-110.

2199. Thomas, Jack Ward, John D. Gill, James C. Pack, William M. Healy, and H. Reed Sanderson.
1976. **Influence of forestland characteristics on spatial distribution of hunters.** J. Wildl. Manage. 40:500-506.

2200. Thomas, Jack Ward, and R. G. Marburger.
1971. **Quantity vs. quality. Part 1. Symptoms of deer herd over-population.** Texas Parks and Wildl. 24(9):16-19.

2201. Thomas, Jack Ward, and R. G. Marburger.
1971. **Quantity vs. quality, Part 2. A deer management decision.** Texas Parks and Wildl. 24(1):6-9.

2202. Thomas, Jack Ward, Rodney G. Marburger, and Calvin van Hoozer.
1973. **Rio Grande turkey migrations as related to harvest regulation in Texas.** *In* Wild turkey management. Univ. Mo. Press, Columbia. p. 301-308.

2203. Thomas, Jack W., and James C. Pack.
1969. **Joe Typical: Profile of a hunter.** Outdoor W. Va. 32:19-20.

2204. Thomas, Jack Ward, James C. Pack, John D. Gill, and R. Wayne Bailey.
1973. **Even-age management, turkeys, and turkey hunters: A new study.** *In* Wild turkey management. Univ. Mo. Press, Columbia. p. 273-276.

2205. Thomas, Jack Ward, James C. Pack, William M. Healy, John D. Gill, and H. Reed Sanderson.
1973. **Territoriality among hunters: The policy implications.** *In* Transactions of the 38th North American wildlife and natural resources conference. Wildl. Manage. Inst. p. 274-280.

2206. Thomas, J. W., R. M. Robinson, and R. G. Marburger.
1967. **Use of diazepam in the capture and handling of cervids.** J. Wildl. Manage. 31:686-692.

2207. Thomas, J. W., R. M. Robinson, and R. G. Marburger.
1970. **Studies in hypogonadism in white-tailed deer.** Texas Parks & Wildl. Dep. Tech. Ser. 5. 50 p.

2208. Thor, Eyvind, George Rink, and William T. Plass.
1974. **Breeding Virginia pine for better growth on acid spoil.** 2nd Res. and Appl. Tech. Symp. on Mined-Land Reclam. Natl. Coal Assoc. p. 168-174.

2209. Timson, Floyd G.
1970. **Hardwood log weighing and its potential use.** North. Logger 19(2):24-25, 66-67.

2210. Timson, Floyd G.
1972. **Sawlog weights for Appalachian hardwoods.** USDA For. Serv. Res. Pap. NE-222. 29 p.

2211. Timson, Floyd G.
1974. **Weight and volume variation in truckloads of logs hauled in the central Appalachians.** USDA For. Serv. Res. Pap. NE-300. 9 p.

2212. Timson, Floyd G.
1975. **Forwarders come to the Appalachian Mountains.** North. Logger 24(2):14-15, 36-37.

2213. Timson, Floyd G.
1975. **Weight/volume ratios for Appalachian hardwoods.** USDA For. Serv. Res. Note NE-202. 2 p.

2214. Timson, Floyd G., and Thomas W. Church, Jr.
1972. **Appalachian loggers wrestle very few heavyweights!** North. Logger 20(10):26,28.

2215. Tombaugh, Larry W.
1971. **External benefits of natural environments.** *In* Recreation symp. proc. USDA For. Serv. Northeast. For. Exp. Stn. p. 73-77.

2216. Townsend, Alden M.
1976. **Selection and breeding of maples for urban areas.** *In* Better trees for metropolitan landscapes symp. proc. USDA For. Serv. Gen. Tech. Rep. NE-22. p. 195-202.

2217. Townsend, A. M., and L. S. Dochinger.
1974. **Relationship of seed source and developmental stage to the ozone tolerance of *Acer rubrum* seedlings.** Atmos. Environ. 8:957-964.

2218. Trent, Roy E., R. O. Weedfall, and W. H. Dickerson.
1970. **West Virginia climate in relation to weather sensitive industry.** W. Va. Univ. Agric. Exp. Stn. Bull. 591T. 26 p.

2219. Trimble, G. R., Jr.
1968. **Harvest cuttings in Appalachian hardwoods from a silvicultural viewpoint.** West Md. For. Improv. Conf. Proc. 9 p.

2220. Trimble, G. R., Jr.
1968. **Research findings on even-aged management of hardwoods in the Appalachian area and the Central States.** Monongahela Natl. For. Timber Manage. Conf. Proc. 15 p.

2221. Trimble, G. R., Jr.
1972. **Reproduction 7 years after seed-tree harvest cutting in Appalachian hardwoods.** USDA For. Serv. Res. Pap. NE-223. 19 p.

2222. Trimble, G. R., Jr.
1973. **Appalachian mixed hardwoods.** *In* Silvicultural systems for the major forest types of the United States. U.S. Dep. Agric., Agric. Handb. 445. p. 80-82.

2223. Trimble, G. R., Jr.
1973. **Natural regeneration of central Appalachian hardwoods in West Virginia.** Hardwood Symp., Hardwood Res. Counc. Cashiers, N.C. 13 p.

2224. Trimble, G. R., Jr.
1973. **The regeneration of central Appalachian hardwoods with emphasis on the effects of site quality and harvesting practice.** USDA For. Serv. Res. Pap. NE-282. 14 p.

2225. Trimble, G. R., Jr.
1973. **Response to crop-tree release by 7-year-old stems of yellow-poplar and black cherry.** USDA For. Serv. Res. Pap. NE-253. 10 p.

2226. Trimble, G. R., Jr.
1974. **Response to crop-tree release by 7-year-old stems of red maple stump sprouts and northern red oak advance reproduction.** USDA For. Serv. Res. Pap. NE-303. 6 p.

2227. Trimble, George R., Jr.
1967. **Diameter increase in second-growth Appalachian hardwood stands: A comparison of species.** USDA For. Serv. Res. Note NE-75. 5 p.

2228. Trimble, George R., Jr.
1968. **Form recovery by understory sugar maple under uneven-aged management.** USDA For. Serv. Res. Note NE-89. 8 p.

2229. Trimble, George R., Jr.
1968. **Growth of Appalachian hardwoods as affected by site and residual stand density.** USDA For. Serv. Res. Pap. NE-98. 13 p.

2230. Trimble, George R., Jr.
1968. **Log grades should reflect lumber grades.** North. Logger 16(11):24.

2231. Trimble, George R., Jr.
1968. **Multiple stems and single stems of red oak give same site index.** J. For. 66:198.

2232. Trimble, George R., Jr.
1969. **Diameter growth of individual hardwood trees: The effect of certain tree and environmental factors on the growth of several species.** USDA For. Serv. Res. Pap. NE-145. 25 p.

2233. Trimble, George R., Jr.
1969. **More intensive forest management ahead in Northeast and Appalachians.** 1969 Pulpwood Annu. p. 105-106.

2234. Trimble, George R., Jr.
1969. **Panel comments.** *In* Proc. sugar maple conference, 1968. Mich. Tech. Univ., Houghton. p. 28.

2235. Trimble, George R., Jr.
1970. **20 years of intensive uneven-aged management.** USDA For. Serv. Res. Pap. NE-154. 12 p.

2236. Trimble, George R., Jr.
1971. **Diameter-limit cutting in Appalachian hardwoods: Boon or bane?** USDA For. Serv. Res. Pap. NE-208. 14 p.

2237. Trimble, George R., Jr.
1971. **Early crop-tree release in even-aged stands of Appalachian hardwoods.** USDA For. Serv. Res. Pap. NE-203. 12 p.

2238. Trimble, George R., Jr.
1971. **Some hardwood culls do not need treatment...and these can be identified.** North. Logger 20(1):12,32-33.

2239. Trimble, George R., Jr.
1975. **Summaries of some silvical characteristics of several Appalachian hardwood trees.** USDA For. Serv. Gen. Tech. Rep. NE-16. 5 p.

2240. Trimble, George R., Jr., and Lester McClung.
1966. **Clearcutting.** W. Va. Conserv. 30(7):16-18.

2241. Trimble, George R., Jr., and Lester McClung.
1966. **Clearcutting profitable.** W. Va. Conserv. 30(9):2-4.

2242. Trimble, G. R., and C. E. McGee.
1973. **Natural regeneration of central Appalachian hardwoods in West Virginia.** Proc. 1st Annu. Hardwood Symp. Hardwood Res. Counc. p. 45-53.

2243. Trimble, G. R., Jr., and Robert S. Manthy.
1966. **Implication of even-aged management on timber.** Proc. Annu. Winter meet. Allegheny Sect. Soc. Am. For. p. 62-75.

2244. Trimble, George R., Jr., and Joseph J. Mendel.
1969. **The rate of value increase for northern red oak, white oak, and chestnut oak.** USDA For. Serv. Res. Pap. NE-129. 29 p.

2245. Trimble, George R., Jr., Joseph J. Mendel, and Richard A. Kennell.
1974. **A procedure for selection marking in hardwoods combining silvicultural considerations with economic guidelines.** USDA For. Serv. Res. Pap. NE-292. 13 p.

2246. Trimble, George R., Jr., James H. Patric, John D. Gill, George H. Moeller, and James N. Kochenderfer.
1974. **Some options for managing forest land in the central Appalachians.** USDA For. Serv. Gen. Tech. Rep. NE-12. 42 p.

2247. Trimble, G. R., Jr., and R. L. Rosier.
1972. **Elimination of scattered residual saplings left after clearcut harvesting of Appalachian hardwoods.** USDA For. Serv. Res. Note NE-146. 4 p.

2248. Trimble, George R., Jr., and Donald W. Seegrist.
1970. **Distribution of diameter growth rates and clear stem lengths as a basis for selecting superior phenotypes.** USDA For. Serv. Res. Pap. NE-160. 11 p.

2249. Trimble, George R., and Donald W. Seegrist.
1973. **Epicormic branching on hardwood trees bordering forest openings.** USDA For. Serv. Res. Pap. NE-261. 6 p.

2250. Trimble, G. R., Jr., and H. Clay Smith.
1970. **Sprouting of dormant buds on border trees.** USDA For. Serv. Res. Pap. NE-179. 8 p.

2251. Trimble, George R., Jr., and H. Clay Smith.
1976. **Stand structure and stocking control in Appalachian mixed hardwoods.** USDA For. Serv. Res. Pap. NE-340. 10 p.

2252. Trimble, G. R., Jr., and E. H. Tryon.
1966. **Crown encroachment into openings cut in Appalachian hardwood stands.** J. For. 64:104-108.

2253. Trimble, G. R., Jr., and E. H. Tryon.
1967. **Seeding characteristics of eleven Appalachian hardwood species.** USDA For. Serv. Northeast. For. Exp. Stn. 20 p.

2254. Trimble, George R., Jr., and E. H. Tryon.
1969. **Survival and growth of yellow-poplar seedlings depend on date of germination.** USDA For. Serv. Res. Note NE-101. 6 p.

2255. Trimble, G. R., Jr., and E. H. Tryon.
1974. **Grapevines a serious obstacle to timber production on good hardwood sites in Appalachia.** North. Logger 23(5):22-23, 44.

2256. Trimble, George R., Jr., and Earl H. Tryon.
1976. **Grapevine control in even-aged hardwood stands.** W. Va. Univ. For. Notes 6. p. 12-14.

2257. Trimble, G. R., Jr., and E. H. Tryon.
1976. **Grapevine control in young even-aged hardwood stands.** North. Logger 24(9):12-13.

2258. Trimble, George R., Jr., and George W. Wendel.
1966. **A cost figure for chemical release in Appalachian hardwoods.** North. Logger 14(7):24,42.

2259. Troendle, Charles A.
1970. **A comparison of soil-moisture loss from forested and clearcut areas in West Virginia.** USDA For. Serv. Res. Note NE-120. 8 p.

2260. Troendle, Charles A.
1970. **The flow interval method for analyzing timber harvesting effects on streamflow regimen.** Water Resour. Res. 6:328-332.

2261. Troendle, Charles A.
1970. **Water storage, movement, and outflow from a forested slope under natural rainfall in West Virginia.** (Abstr.) Am. Geophys. Union Trans. 51(4):279.

2262. Troendle, C. A., G. M. Aubertin, and J. N. Kochenderfer.
1974. **Decomposition of the forest floor following deforestation and annual herbiciding.** Agron. Abstr. Am. Soc. Agron. Meet. Div. S-7:179.

2263. Troendle, C. A., and J. W. Homeyer.
1971. **Stormflow related to measured physical parameters on small forested watersheds in West Virginia.** Am. Geophys. Union Trans. 52(4):204.

2264. Troendle, Charles A., and James D. Phillips.
1970. **Evaporation: Rain falling up.** W. Va. Agric. and For. 3(2):5,11-12.

2265. Tryon, E. H., and G. R. Trimble, Jr.
1970. **Effect of distance from stand border on height of hardwood reproduction in openings.** W. Va. Acad. Sci. Proc. 41. p. 125-132.

2266. Tubbs, Carl H.
1969. **Natural regeneration of yellow birch in the Lake States.** *In* Birch symp. proc. USDA For. Serv. Northeast. For. Exp. Stn. p. 74-78.

2267. Turnock, W. J., and J. A. Muldrew.
1971. **Parasites.** *In* Toward integrated control. Proc. 3rd Annu. Northeast. For. Insect Work Conf. USDA For. Serv. Res. Pap. NE-194. p. 59-87.

2268. Ulеck, Ronald B.
1971. **The challenge of recreation planning: Methodology and factors to consider.** *In* Recreation symp. proc. USDA For. Serv. Northeast. For. Exp. Stn. p. 200-211.

2269. U.S. Forest Service.
1969. **Forests for the future.** USDA For. Serv. East. Reg. and Northeast. For. Exp. Stn. 10 p.

2270. U.S. Forest Service.
1971. **Forests for the future.** (Rev.) USDA For. Serv. Northeast. For. Exp. Stn. and East. Reg. 8 p.

2271. U.S. Forest Service.
1973. **Enjoy your fireplace, especially during the energy crisis.** USDA For. Serv. Northeast. For. Exp. Stn. and Northeast. Area, State and Priv. For. 7 p.

2272. U.S. Forest Service.
1973. **Wounded trees mar our environment.** USDA For. Serv. Northeast. For. Exp. Stn. and Northeast. Area, State and Priv. For. 13 p.

2273. Valentine, H. T., and R. W. Campbell.
1975. **A simulation model of gypsy moth-forest interaction.** For. Sci. 21:233-238.

2274. Valentine, Harry T., Carlton M. Newton, and Robert L. Talerico.
1976. **Compatible systems and decision models for pest management.** Environ. Entomol. 5:891-900.

2275. Van Buijtenen, J. P.
1967. **Pulpwood properties and tree breeding: A synthesis.** 14th IUFRO Congr. Pap. 9 Sect. 41. p. 244-262.

2276. Van Buijtenen, J. P.
1967. **Quality control begins in the woods.** For. Biol. Conf. Proc. 4. p. 102-110.

2277. Van Buijtenen, J. P.
1969. **Controlling wood properties by forest management.** TAPPI 52(2):257-259.

2278. Van Buijtenen, J. P., and Frank S. Santamour, Jr.
1972. **Resin crystallization related to weevil resistance in white pine *(Pinus strobus).*** Can. Entomol. 104:215-219.

2279. Van Buijtenen, J. P., and K. Stern.
1967. **Marginal populations and provenance research.** 14th IUFRO Congr. Pap. 3 Sect. 22. p. 319-331.

2280. Van Dyne, G. M., and W. G. Vogel.
1967. **Relation of *Selaquinella densa* to site, grazing, and climate.** Ecology 48:438-444.

2281. Van Lear, David H.
1971. **Effects of spoil texture on growth of K-31 tall fescue.** USDA For. Serv. Res. Note NE-141. 7 p.

2282. Vilkitis, James R.
1974. **Cherries.** *In* Shrubs and vines for northeastern wildlife. USDA For. Serv. Gen. Tech. Rep. NE-9. p. 23-25.

2283. Vogel, Willis G.
1970. **Weeping lovegrass for vegetating strip-mine spoils in Appalachia.** 1st Weeping Lovegrass Symp. Proc. 1. p. 152-162. Noble Found., Ardmore, Okla.

2284. Vogel, Willis G.
1971. **Needs in revegetation research on surface-mined lands.** *In* Revegetation and economic use of surface-mined land and mine refuse symp. proc. W. Va. Univ. Sch. Mines, Morgantown. p. 17-18.

2285. Vogel, Willis G.
1973. **The effect of herbaceous vegetation on survival and growth of trees planted on coal-mine spoils.** Proc. Res. and Appl. Tech. Symp. on Mined-Land Reclam. Bituminous Coal Res. Inc. p. 197-207.

2286. Vogel, Willis G.
1974. **All-season seeding of herbaceous vegetation for cover on Appalachian strip-mine spoils.** Symp. Mine and Prep. Plant Refuse Disposal Proc. Natl. Coal Assoc. p. 175-188.

2287. Vogel, Willis G.
1974. ***Lespedeza* Michx: Lespedeza.** *In* Seeds of woody plants in the United States. U.S. Dep. Agric. Agric. Handb. 450. p. 488-490.

2288. Vogel, Willis.
1975. **Requirements and use of fertilizer, lime, and mulch for vegetating acid mine spoils.** Natl. Coal Assoc. Surface Min. and Reclam. Symp. 3 (Vol. 2):152-170.

2289. Vogel, W. G., and W. A. Berg.
1968. **Grasses and legumes for cover on acid strip-mine spoils.** J. Soil & Water Conserv. 23:89-91.

2290. Vogel, Willis G., and William A. Berg.
1973. **Fertilizer and herbaceous cover influence establishment of direct-seeded black locusts on coal-mine spoils.** *In* Ecology and reclamation of devastated land, vol. II. Gordon & Breach, New York. p. 189-198.

2291. Vogel, W. G., and A. J. Bjugstad.
1968. **Effects of clipping on yield and tillering of little bluestem, big bluestem, and indiangrass.** J. Range Manage. 21:136-140.

2292. von Althen, F. W.
1973. **Fertilization of juvenile hardwoods.** *In* Forest fertilization symp. proc. USDA For. Serv. Gen. Tech. Rep. NE-3. p. 183-187.

2293. Vozzo, J. A., and Edward Hacskaylo.
1974. **Endo- and ectomycorrhizal associations in five *populus* species.** Torrey Bot. Club Bull. 101:182-186.

2294. Wagar, J. Alan.
1971. **Communicating with recreationists.** *In* Recreation symp. proc. USDA For. Serv. Northeast. For. Exp. Stn. p. 161-165.

2295. Wagar, J. Alan.
1975. **Effectiveness in interpretation.** Interpreter 7(3):6-11.

2296. Wagar, J. Alan.
1976. **Achieving effectiveness in environmental interpretation.** *In* Southern states recreation research application workshop proc. USDA For. Serv. Gen. Tech. Rep. SE-9. p. 90-105.

2297. Wagar, J. Alan.
1976. **Land-use planning: A view from Holland.** J. For. 74:13-17.

2298. Wahlgren, Harold E., Gregory Baker, Robert R. Maeglin, and Arthur C. Hart.
1968. **Survey of specific gravity of eight Maine conifers.** USDA For. Serv. Res. Pap. FPL-95. 12 p.

2299. Wahlgren, Harold E., Arthur C. Hart, and Robert R. Maeglin.
1966. **Estimating tree specific gravity of Maine conifers.** USDA For. Serv. Res. Pap. FPL-61. 22 p.

2300. Wallace, Oliver P.
1969. **Management of birch for other uses.** Birch symp. proc. USDA For. Serv. Northeast. For. Exp. Stn. p. 176-177.

2301. Wallace, Oliver P., Sr., and Richard D. Hopkins.
1968. **Estimated financial returns from two white pine plantations.** N.H. Agric. Exp. Stn. Bull. 496. 24 p.

2302. Wallin, W. B.
1973. **Required pallet research: Economic aspects.** *In* Opportunities for Virginia's pallet industry. Va. Polytech. Inst. and State Univ., Blacksburg. p. 32-38.

2303. Wallin, W.B., and E.G. Stern.
1974. **Tentative nailing standards for warehouse and exchange pallets.** Va. Polytech. Inst. and State Univ. Wood Res. and Wood Constr. Lab., Pallet and Container Res. Cent. Publ. 129. 16 p.

2304. Wallin, Walter B., and E. George Stern.
1976. **Comparative performance of southern pine pallets. Part II.** Va. Polytech. Inst. and State Univ. Wood Res. and Wood Constr. Lab., Pallet and Container Res. Cent. Publ. 142. 20 p.

2305. Wallin, Walter B., and E. George Stern.
1976. **Eucalyptus warehouse and exchange pallets.** Va. Polytech. Inst. and State Univ. Wood Res. and Wood Constr. Lab., Pallet and Container Res. Cent. Publ. 147. 30 p.

2306. Wallin, W.B., E.G. Stern, and J.J. Strobel.
1975. **Pallet exchange-program research findings indicate need for pallet standards.** Va. Polytech. Inst. and State Univ. Wood Res. and Wood Constr. Lab., Pallet and Container Res. Cent. Publ. 134. 12 p.

2307. Walters, Russell S.
1967. **Marketing other products of the forest.** Ky. Governor's Conf. For. Proc. 4. p. 53-59.

2308. Walters, Russell S.
1967. **Other products of the forest.** Ohio Woodlands 6(1):17-18.

2309. Walters, Russell S.
1967. **Straight talk about Christmas tree planting.** Am. Christmas Tree J. 11(1):24-25.

2310. Walters, Russell S.
1968. **Christmas tree report.** Ohio Woodlands 6(2):16-18.

2311. Walters, Russell S.
1968. **Scotch pine seed available from Turkey.** Am. Christmas Tree J. 12(3):9.

2312. Walters, Russell S.
1970. **Shaping Christmas trees with chemicals.** Am. Christmas Tree J. 14(2):23-26.

2313. Walters, Russell S.
1971. **White pine provenances for Christmas trees in eastern Kentucky and Ohio.** USDA For. Serv. Res. Pap. NE-185. 16 p.

2314. Walters, Russell S.
1974. **Bud-pinching of Scotch pine Christmas trees—yes and no.** Am. Christmas Tree J. 18(2):5-7.

2315. Walters, Russell S.
1975. **Collecting maple sap with plastic pipelines and vacuum pumps.** Natl. Maple Syrup Dig. 14(3):14-17.

2316. Walters, Russell S., and O. M. Davenport.
1969. **Early spring straightening can save crooked trees.** Am. Christmas Tree J. 13(1):7-10.

2317. Walters, Russell S., and William J. Gabriel.
1974. **Sugar maple sap-flow rate and sap volume.** Natl. Maple Syrup Dig. 13(3):12-14.

2318. Walters, R. S., and H. C. Smith.
1972. **Fall tapping.** Natl. Maple Syrup Dig. 11(2):12-13.

2319. Walters, R. S., and H. C. Smith.
1972. **Taphole numbers and tubing size.** Natl. Maple Syrup Dig. 11(3):10-13.

2320. Walters, Russell S., and H. Clay Smith.
1975. **Sugar maple sap volume increases as vacuum level is increased.** USDA For. Serv. Res. Note NE-213. 4 p.

2321. Walton, Gerald S.
1970. **A note on nonrandomized Neyman-shortest unbiased confidence intervals for the binomial and Poisson parameters.** Biometrika 57(1):223-224.

2322. Walton, Gerald S., and C. J. DeMars.
1973. **Empirical methods in the evaluation of estimators.** USDA For. Serv. Res. Pap. NE-272. 15 p.

2323. Walton, G. S., and C. J. DeMars.
1974. **Empirical methods in the evaluation of estimators.** *In* Statistics in forestry research. 4th IUFRO Conf. Advis. Group For. Stat. p. 161-164.

2324. Wargo, P.M.
1975. **Lysis of the cell wall of *Armillaria mellea* by enzymes from forest trees.** Physiol. Plant Pathol. 5:99-105.

2325. Wargo, Philip M.
1971. **Enhanced growth of *Armillaria mellea* on extracts from roots of defoliated sugar maple trees.** (Abstr.) Phytopathology 61:915.

2326. Wargo, Philip M.
1971. **Seasonal changes in carbohydrate levels in roots of sugar maple.** USDA For. Serv. Res. Pap. NE-213. 8 p.

2327. Wargo, Philip M.
1972. **Defoliation-induced chemical changes in sugar maple roots stimulate growth of *Armillaria mellea*.** Phytopathology 62:1278-1283.

2328. Wargo, Philip M.
1974. **Lysis of the cell wall of *A. mellea* by enzymes from forest trees.** (Abstr.) Phytopathology 64:588.

2329. Wargo, Philip M.
1975. **Estimating starch content in roots of deciduous trees: A visual technique.** USDA For. Serv. Res. Pap. NE-313. 9 p.

2330. Wargo, Philip M.
1976. **Lysis of fungal pathogens by tree produced enzymes: A possible disease resistance mechanism in trees.** 23rd Northeast. For. Tree Improv. Conf. Proc. p. 19-23.

2331. Wargo, Philip M.
1976. **Variation of starch content among and within roots of red and white oak trees.** For. Sci. 22:468-471.

2332. Wargo, P. M., and D. R. Houston.
1973. **Infection of defoliated sugar maple trees by *Armillaria mellea*.** Phytopathology 63:209.

2333. Wargo, Philip M., and David R. Houston.
1974. **Infection of defoliated sugar maple trees by *Armillaria mellea*.** Phytopathology 64:817-822.

2334. Wargo, Philip M., Johnson Parker, and David R. Houston.
1972. **Starch content in roots of defoliated sugar maple.** For. Sci. 18:203-204.

2335. Wargo, Philip M., and H. Richard Skutt.
1975. **Resistance to pulsed electric current: An indicator of stress in forest trees.** Can. J. For. Res. 5:557-561.

2336. Wartluft, Jeffrey L.
1971. **Measuring bark residues from red oak saw logs.** South. Lumberman 223(2776):167-168.

2337. Wartluft, Jeffrey L.
1971. **The use and market for wood in the electrometallurgical industry.** USDA For. Serv. Res. Pap. NE-191. 12 p.

2338. Wartluft, Jeffrey L.
1974. **Baling hardwood bark with a vertical baler.** North. Logger 22(12):22.

2339. Wartluft, Jeffrey L.
1974. **Yield table for hardwood bark residue.** USDA For. Serv. Res. Note NE-199. 4 p.

2340. Wartluft, Jeffrey L.
1975. **Double-drum sawdust stove.** USDA For. Serv. Res. Note NE-208. 4 p.

2341. Wartluft, Jeffrey L.
1976. **A suggested glossary of terms and standards for measuring wood and bark mill residues.** USDA For. Serv. Res. Note NE-217. 8 p.

2342. Wartluft, Jeffrey L., and Charles H. Wolf.
1968. **Profit possibilities with hardwood bark.** South. Lumberman 217(2704):217-219.

2343. Waters, W. E.
1970. **The case for forest entomology.** J. For. 68:73-77.

2344. Waters, William E.
1969. **Forest insect population dynamics: Some basic considerations.** *In* Forest insect population dynamics. USDA For. Serv. Res. Pap. NE-125. p. 1-7.

2345. Waters, William E.
1969. **The life table approach to analysis of insect impact.** J. For. 67:300-304.

2346. Waters, W. E., and R. J. Finnegan.
1967. **Pales weevil *Hylobius pales* (Hbst.).** *In* Important forest insects and diseases of mutual concern to Canada, the United States and Mexico. Can. Dep. For. Rural Dev. Publ. 1180. p. 108-110.

2347. Watt, K. E. P.
1969. **Methods of developing large-scale systems models.** *In* Forest insect population dynamics. USDA For. Serv. Res. Pap. NE-125. p. 35-51.

2348. Watt, Richard F., Kenneth A. Brinkman, and B. A. Roach.
1973. **Oak-hickory.** *In* Silvicultural systems for the major forest types of the United States. U.S. Dep. Agric., Agric. Handb. 445. p. 66-69.

2349. Wayt, William A., Robert W. Acton, James C. Whittaker.
1968. **A look at commercial recreation on small woodlands in Ohio.** USDA For. Serv. Res. Pap. NE-101 11 p.

2350. Webb, Charles D.
1970. **Genetics and tree improvement in the oak—yellow-poplar type.** *In* The silviculture of oaks and associated species. USDA For. Serv. Res. Pap. NE-144. p. 57-66.

2351. Webster, Henry H., and John C. Meadows, Jr.
1971. **Economic evaluation of intermediate operations in oak stands.** *In* Oak symp. proc. USDA For. Serv. Northeast. For. Exp. Stn. p. 74-83.

2352. Weetman, Gordon F., and Stuart B. Hill.

1973. **General environmental and biological concerns in relation to forest fertilization.** *In* Forest fertilization symp. proc. USDA For. Serv. Gen. Tech. Rep. NE-3. p. 19-35.

2353. Weidhaas, John A., Jr.
1976. **Is host resistance a practical goal for control of shade-tree insects?** *In* Better trees for metropolitan landscapes symp. proc. USDA For. Serv. Gen. Tech. Rep. NE-22. p. 127-133.

2354. Weigle, Weldon K.
1966. **Erosion from abandoned coal-haul roads.** J. Soil & Water Conserv. 21:98.

2355. Weigle, Weldon K.
1966. **Road erosion and spoil-bank stability.** Pa. State Univ. Coal Mine Spoil Reclam. Symp. Proc. 1965. p. 82-85.

2356. Weigle, Weldon K.
1966. **Spoil bank stability in eastern Kentucky.** Min. Congr. J. 52(4):67-73.

2357. Weigle, Weldon K., and George P. Williams, Jr.
1968. **Match additive to soil types for best stabilization.** Rural and Urban Roads, June 1968. p. 24-25.

2358. Wen, C. Y., and H. P. Simons.
1966. **Utilization of forestry wastes for power generation.** *In* Forest engineering symp. proc. W. Va. Univ. Tech. Bull. 82. p. 95-99.

2359. Wendel, G. W.
1971. **Converting hardwoods on poor sites to white pine by planting and direct seeding.** USDA For. Serv. Res. Pap. NE-188. 19 p.

2360. Wendel, G. W.
1972. **Longevity of black cherry seed in the forest floor.** USDA For. Serv. Res. Note NE-149. 4 p.

2361. Wendel, G. W.
1974. *Celastrus scandens* **L.: American bittersweet.** *In* Seeds of woody plants in the United States. U.S. Dep. Agric., Agric. Handb. 450. p. 295-297.

2362. Wendel, G. W.
1975. **Stump sprout growth and quality of several Appalachian hardwood species after clearcutting.** USDA For. Serv. Res. Pap. NE-329. 9 p.

2363. Wendel, George W.
1966. **Aerial spraying of low-grade hardwood stands with 2,4,5-T in West Virginia.** USDA For. Serv. Res. Note NE-45. 4 p.

2364. Wendel, George M.
1967. **Seedbed scarification from horse skidding during clearcutting.** North. Logger 15(8):12, 27.

2365. Wendel, George W.
1972. **Results of a 20-year test of hybrid poplars in West Virginia.** USDA For. Serv. Res. Pap. NE-237. 5 p.

2366. Wendel, G. W., and F. C. Cech.
1975. **Recovery of herbicide-damaged eastern white pine.** Tree Plant. Notes 26(4):18-20.

2367. Wendel, G. W., and Franklin Cech.
1976. **Six-year results of a white pine seed-source test in West Virginia.** USDA For. Serv. Res. Note NE-224. 4 p.

2368. Wendel, G. W., and W. J. Gabriel.
1975. **Sugar maple provenance study: West Virginia outplanting 6-year results.** 22nd Northeast. For. Tree Improv. Conf. Proc. p. 163-171.

2369. Wendel, G. W., James N. Kochenderfer, and Cleveland J. Biller.
1974. **Skyline cable logging in West Virginia.** North. Logger 22(12):14-15.

2370. Wendel, George W., and George R. Trimble, Jr.
1968. **Early reproduction after seed-tree harvest cuttings in Appalachian hardwoods.** USDA For. Serv. Res. Pap. NE-99. 16 p.

2371. Werner, Robert G.
1973. **Water quality: Limnological concerns about forest fertilization.** *In* Forest fertilization symp. proc. USDA For. Serv. Gen. Tech. Rep. NE-3. p. 72-78.

2372. West Virginia Department of Natural Resources.
1973. **The primary forest industry of West Virginia, 1973.** W. Va. Dep. Nat. Resour. Bull. 72 p.

2373. Whipkey, R. Z.
1969. **Storm runoff from forested catchments by subsurface routes.** *In* Floods and their computation. Int. Assoc. Sci. Hydrol. Symp. Proc. 1967. p. 773-779.

2374. Whipkey, R. Z.
1970. **Water control on experimental forest watersheds.** J. Soil & Water Conserv. 25:238-239.

2375. Whipkey, Ronald Z.
1967. **Theory and mechanics of subsurface stormflow.** *In* International symp. on forest hydrology proc. Pergamon Press, Oxford, England. p. 255-260.

2376. White, James R., and William T. Plass.
1974. **Sediment control using modified mining and regrading systems and sediment control structures.** 2nd Res. and Appl. Tech. Symp. on Mined-Land Reclam. Natl. Coal Assoc. p. 117-123.

2377. Whittaker, J. C.
1966. **Commercial outdoor recreation: An important use of Ohio's lakes and ponds.** Ohio Woodlands 6(2):3.

2378. Whittaker, James C.
1966. **How to increase profits sawing small logs into thick lumber and timbers.** South. Lumberman 213(2656): 129-130.

2379. Whittaker, James C.
1968. **Land leasing: An aid to developing outdoor recreation enterprises in Indiana, Kentucky, and Ohio.** USDA For. Serv. Res. Pap. NE-113. 12 p.

2380. Whittaker, J. C., and H. E. Echelberger.
1968. **New York Section members' attitudes about forest recreation and associated research.** N.Y. For. 25(1 and 2):48-50.

2381. Whittaker, James C., and Herbert E. Echelberger.
1971. **Land for recreation: A look at leasing in New York.** USDA For. Serv. Res. Pap. NE-182. 8 p.

2382. Whittaker, James C., and Orris D. McCauley.
1966. **Costs and returns for hardwood lumber production in the Appalachian region of Kentucky and Ohio.** USDA For. Serv. Res. Pap. NE-55. 10 p.

2383. Whitten, R. R., and W. A. Reeks.
1967. **European pine sawfly *Neodiprion sertifer* (Geoff.).** *In* Important forest insects and diseases of mutual concern to Canada, the United States and Mexico. Can. Dep. For. Rural Dev. Publ. 1180. p. 134-137.

2384. Whitten, R. R., and W. A. Reeks.
1967. **Native elm bark beetle *Hylurgopinus rufipes* (Eichhoff).** *In* Important forest insects and diseases of mutual concern to Canada, the United States and Mexico. Can. Dep. For. Rural Dev. Publ. 1180. p. 114-116.

2385. Whitten, R. R., and W. A. Reeks.
1967. **Smaller European elm bark beetle *Scolytus multistriatus* (Marsham).** *In* Important forest insects and diseases of mutual concern to Canada, the United States and Mexico. Can. Dep. For. Rural Dev. Publ. 1180. p. 167-170.

2386. Wiackowski, S. K., and L. S. Dochinger.
1973. **Interactions between air pollution and insect pests in Poland.** 2nd Int. Congr. Plant Pathol. Abstr. 0736. 1 p.

2387. Wiant, Harry V., Jr., Joseph E. Barnard, and Miguel A. Ramirez.
1976. **Relating tree species to site quality in mixed Appalachian forests.** W. Va. Univ. For. Notes 6. p. 17-21.

2388. Wiant, Harry V., Jr., Miguel A. Ramirez, and Joseph E. Barnard.
1975. **Species composition as a predictor of site quality in mixed Appalachian hardwoods.** Proc. 3rd Annu. Hardwood Symp. Hardwood Res. Counc. p. 80-83.

2389. Wilkinson, Ronald C.
1973. **Inheritance and correlation of growth characters in hybrid popular clones.** 20th Northeast. For. Tree Improv. Conf. Proc. p. 121-130.

2390. Wilkinson, Ronald C.
1974. **Realized and estimated efficiency of early selection in hybrid poplar clonal tests.** 21st Northeast. For. Tree Improv. Conf. Proc. p. 26-32.

2391. Wilkinson, Ronald C.
1975. **Silicone antitranspirant increases susceptibility of eastern white pine to the white-pine weevil.** USDA For. Serv. Res. Pap. NE-326. 5 p.

2392. Wilkinson, R. C., and J. W. Hanover.
1972. **Geographical variation in the monoterpene composition of red spruce.** Phytochemistry 11:2007-2010.

2393. Wilkinson, R. C., J. W. Hanover, J. W. Wright, and R. H. Flake.
1971. **Genetic variation in the monoterpene composition of white spruce (*Picea glauca* (Moench) Voss).** For. Sci. 17:83-90.

2394. Williams, Carroll B., Jr., and Patrick J. Shea.
1971. **Insecticides.** *In* Toward integrated control. Proc. 3rd Annu. Northeast. For. Insect Work Conf. USDA For. Serv. Res. Pap. NE-194. p. 88-110.

2395. Williams, George P.
1967. **Roads, slides, and check dams.** Ky. Dep. Nat. Resour. Strip Min. Symp. Proc. 4 p.

2396. Williams, George P., Jr.
1973. **Changed spoil dump shape increases stability on contour strip mines.** Proc. Res. and Appl. Tech. Symp. on Mined-Land Reclam. Bituminous Coal Res. Inc. p. 243-249.

2397. Williamson, Malcolm J.
1966. **Premature abscissions and white oak acorn crops.** For. Sci. 12:19-21.

2398. Williamson, Robert D.
1973. **Bird- and people-neighborhoods.** Nat. Hist. 82:55-57.

2399. Williamson, Robert D.
1974. **Birds in Washington, D.C.** *In* Wildlife in an urbanizing environment. Univ. Mass. Holdsworth Nat. Resour. Cent. Plann. Dev. Ser. 28. p. 131-136.

2400. Wilson, Charles L., and Carl E. Seliskar.
1976. **Mycoplasma-associated diseases of trees.** J. Arboric. 2(1):6-12.

2401. Wilson, Charles L., Carl E. Seliskar, and Charles R. Krause.
1971. **Mycoplasmalike bodies associated with elm phloem necrosis.** Phytopathology 62:140-143.

2402. Wilson, C. L., and A. L. Shigo.
1973. **Dispelling myths in arboriculture today.** Am. Nurseryman 127:24-28.

2403. Wilson, C. L., and A.L. Shigo.
1974. **Dispelling tree myths.** Plants and Gard. 29(4):14-15.

2404. Wilson, Robert W., Jr.
1969. **Considerations of the relation of various errors to estimates of population dynamics.** *In* Forest insect population dynamics. USDA For. Serv. Res. Pap. NE-125. p. 101-111.

2405. Wilson, Robert W., Jr., and Ashbel F. Hough.
1966. **A selected and annotated bibliography of eastern white pine (*Pinus strobus* L.), 1890-1954.** USDA For. Serv. Res. Pap. NE-44. 166 p.

2406. Wilson, Robert W., Jr., and Robert C. Peters.
1967. **The northeastern forest-inventory data-processing system. I. Introduction.** USDA For. Serv. Res. Pap. NE-61. 20 p.

2407. Wilson, Robert W., Jr., and Robert C. Peters.
1967. **The northeastern forest-inventory data-processing system. II. Description of subsystem edit.** USDA For. Serv. Res. Pap. NE-70. 12 p.

2408. Wilson, Robert W., Jr., and Robert C. Peters.
1967. **The northeastern forest-inventory data-processing system. V. Description of subsystem table.** USDA For. Serv. Res. Pap. NE-73. 11 p.

2409. Wilson, Robert W., Jr., and Robert C. Peters.
1967. **The northeastern forest-inventory data-processing system. VIII. Description of subsystem output.** USDA For. Serv. Res. Pap. NE-76. 7 p.

2410. Woch, W.
1976. **Cell events in cambium connected with the formation and existence of a whirled cell arrangement.** Acta Soc. Bot. Pol. 47:225-231.

2411. Wodzicki, T. J., and Alina B. Wodzicki.
1973. **Auxin stimulation of cambial activity in *Pinus silvestris*. II. Dependence upon basipetal transport.** Physiol. Plant. 29:288-292.

2412. Wodzicki, T. J., and S. Zajaczkowski.
1973. **Effect of auxin on xylem tracheids differentiation in decapitated stems of *Pinus silvestris* L. and its interaction with some vitamins and growth regulators.** Acta Soc. Bot. Pol. 43:129-148.

2413. Wolf, Charles H.
1970. **Wood industry location decisions: A study of plant location procedures and the need for a data bank in West Virginia.** W. Va. Univ. Bull. 70(11-4). 96 p.

2414. Wolf, Charles H.
1973. **Employee turnover: Costs, causes, and methods of control.** North. Logger 22(1):26-27,40,42-43.

2415. Wolf, Charles H.
1973. **Predictors of job tenure in a lumber-plywood mill.** USDA For. Serv. Res. Note NE-164. 4 p.

2416. Wolf, Charles H.
1974. **The effect of monetary incentives on absenteeism: A case study.** USDA For. Serv. Res. Pap. NE-291. 4 p.

2417. Wolf, Charles H.
1974. **Quit rates in wood products industries.** 39th Ind. For. Semin. Proc. p. 37-42.

2418. Wolf, Charles H. and Gilbert P. Dempsey.
1970. **Plant location: By choice or chance?** South. Lumberman 221 (2752):157, 160-162.

2419. Wolf, Charles H., and Jean W. Nolley.
1976. **Mechanization bringing broad changes in makeup of labor force in logging.** For. Ind. 103(10):44-46.

2420. Wolf, Charles H., and Jeffrey L. Wartluft.
1969. **Hardwood bark: From nuisance to nest egg.** North. Logger 18(2):20-21,66-68.

2421. Wolgast, Leonard J.
1974. **Bear oak.** *In* Shrubs and vines for northeastern wildlife. USDA For. Serv. Gen. Tech. Rep. NE-9 p. 108-110.

2422. Wollerman, E. H.
1968. **A search for borer resistance in black locust.** 6th Cent. States For. Tree Improv. Conf. Proc. p. 53-54.

2423. Wollerman, E. H.
1968. **Studies of borer resistance in black locust.** Proc. North Cent. Branch Entomol. Soc. Am. 23:45.

2424. Wollerman, E. H.
1970. **The locust borer.** USDA Agric. For. Serv. For. Pest Leafl. 71 (Rev.) 8 p.

2425. Wollerman, Edward H.
1971. **Boxelder bug.** USDA For. Serv. For. Pest Leafl. 95. (Rev.) 6 p.

2426. Wollerman, Edward H.
1971. **Contributions to locust borer biology.** Proc. North Cent. Branch Entomol. Soc. Am 26:37-40.

2427. Wollerman, Edward H.
1974. **Elm bark beetle dispersal studies.** Proc. North Cent. Branch Entomol. Soc. Am. 29:177.

2428. Wollerman, Edward H., Carol Adams, and George C. Heaton.
1969. **Continuous laboratory culture of the locust borer, *Megacyllene robiniae*.** Ann. Entomol. Soc. Am. 62:647-649.

2429. Wood, Francis A., and Robert A. Schmidt.
1966. **A spore trap for studying spore release from basidiocarps.** Phytopathology 56:50-52.

2430. Wood, Gene W.
1974. **Common spicebush.** *In* Shrubs and vines for northeastern wildlife. USDA For. Serv. Gen. Tech. Rep. NE-9. p. 129-131.

2431. Wood, Gene W.
1974. **Witch-hazel.** *In* Shrubs and vines for northeastern wildlife. USDA For. Serv. Gen. Tech. Rep. NE-9. p. 154-157.

2432. Worley, David P.
1968. **The challenge in education and training.** Ky. Governor's Conf. For. Proc. 5. p. 61-62.

2433. Worley, David P.
1969. **The landowner: His objectives and some management implications.** USDA For. Serv. Northeast. Area, State and Priv. For. CFM Conf. Proc. p. 1-11.

2434. Worley, David P.
1970. **The "Let-it-grow" treatment for timber: Is it economically worthwhile?** USDA For. Serv. Res. Pap. NE-157. 37 p.

2435. Worley, David P.
1974. **A handy guide to rate of increase interpretations.** USDA For. Serv. Res. Note NE-187. 3 p.

2436. Worley, David P.
1975. **Multiple use on municipal watersheds? One way to find an answer.** *In* Municipal watershed management symp. proc. USDA For. Serv. Gen. Tech. Rep. NE-13. p. 170-180.

2437. Worley, David P.
1975. **TSI: Financial and other benefits.** Ky. Governor's Conf. For. Proc. p. 23-30.

2438. Worley, David P., and John D. Gill.
1969. **Strengthening the wildlife manager's hand in multiple-use conflicts.** Trans. Northeast Sect. Wildl. Soc. Northeast Fish Wildl. Conf. 26. p. 11-25.

2439. Worley, David P., and James H. Patric.
1970. **Economic evaluation of some watershed management alternatives on forest land in West Virginia.** (Abstr.) Am. Geophys. Union Trans. 51(4): 280.

2440. Worley, David P., and James H. Patric.
1971. **Economic evaluation of some watershed management alternatives on forest land in West Virginia.** Water Resour. Res. 7:812-818.

2441. Worley, David P., and Hoyt A. Wheeland.
1968. **An economic evaluation of cull-tree removal in mixed hardwood stands.** USDA For. Serv. Res. Note NE-82. 5 p.

2442. Worley, D. Michael, and Charles M. Nixon.
1974. **Elders.** *In* Shrubs and vines for northeastern wildlife. USDA For. Serv. Gen. Tech. Rep. NE-9. p. 48-51.

2443. Wren, Thomas E.
1966. **Rubber-tired skidders: Environmental factors.** North. Logger 14(11):18-19.

2444. Wren, Thomas E.
1966. **A system approach to wheel skidder operations in Appalachian terrain.** *In* Forest engineering symp. proc. W. Va. Univ. Tech. Bull. 82. p. 30-38.

2445. Wright, J. W. and others.
1966. **Performance of Scotch pine varieties in the north central region.** Silvae Genet. 15:101-110.

2446. Writer, Ross, and R. B. Redett.
1971. **The forest heritage of Ohio.** USDA For. Serv. Northeast. For. Exp. Stn. 24 p.

2447. Wu, Kent Y-t., and E. A. McGinnes, Jr.
1974. **Intra-incremental studies of methylation in scarlet oak.** Wood Sci. 7:92-98.

2448. Wysor, Paul S., and Curtis D. Goho.
1969. **How mountains influence highway trucking speeds and costs to Appalachia.** South. Lumberman 219(2728): 135-137.

2449. Yawney, Harry W.
1969. **Artificial regeneration.** *In* Proceedings sugar maple conference, 1968. Mich. Tech. Univ., Houghton. p. 65-74.

2450. Yawney, Harry W., and Clayton M. Carl, Jr.
1968. **Sugar maple seed research.** 20th Anniv. Nurserymen's Conf. Proc. USDA For. Serv. Northeast. Area, State and Priv. For. p. 115-123.

2451. Yawney, Harry W., and Clayton M. Carl, Jr.
1969. **An improved seedling root-volume measuring device.** Tree Plant. Notes 20(3):7-8.

2452. Yawney, Harry W., and Clayton M. Carl, Jr.
1970. **A sugar planting study in Vermont.** USDA For. Serv. Res. Pap. NE-175. 14 p.

2453. Yawney, Harry W., and Clayton M. Carl, Jr.
1974. **Storage requirements for sugar maple seeds.** USDA For. Serv. Res. Pap. NE-298. 7 p.

2454. Yawney, Harry W., and Edward P. Johnson.
1974. **Protecting planted sugar maple seedlings from deer browsing.** Proc. 2nd Annu. Hardwood Symp. Hardwood Res. Counc. p. 97-108.

2455. Yawney, Harry W., and G. R. Trimble, Jr.
1968. **Oak soil-site relationships in the Ridge and Valley region of West Virginia and Maryland.** USDA For. Serv. Res. Pap. NE-96. 19 p.

2456. Yawney, H. W., and R. S. Walters.
1973. **Special forest crops and forest fertilization.** *In* Forest fertilization symp. proc. USDA For. Serv. Gen. Tech. Rep. NE-3. p. 122-131.

2457. Yendol, William G., Ronald A. Hamlen, and Franklin B. Lewis.
1973. **Evaluation of *Bacillus thuringiensis* for gypsy moth suppression.** J. Econ. Entomol. 66:183-186.

2458. Young, Cortland E., Jr., Ralph A. Klawitter, and James E. Henderson.
1971. **Hydrologic model of a wetland forest: Details of construction.** USDA For. Serv. Res. Note SE-166. 4 p.

2459. Young, Cortland E., Jr., Ralph A. Klawitter, and James E. Henderson.
1972. **Hydrologic model of a wetland forest.** J. Soil & Water Conserv. 27:122-124.

2460. Zagórska-Marek, B.
1975. **Growth activity of fusiform initials in storeyed cambium.** Acta Soc. Bot. Pol. 44:537-552.

2461. Zajaczkowski, Stefan.
1973. **Auxin stimulation of cambial activity in *Pinus silvestris.* I. The differential cambial response.** Physiol. Plant 29:281-287.

2462. Zajaczkowski, S., and T. J. Wodzicki.
1975. **Inhibition and requirement of natural stimulator for cambial xylem production in isolated stem segments of *Pinus silvestris.*** Physiol. Plant 33:71-74.

2463. Zerillo, Roger T.
1975. **A photographic technique for estimating egg density of the white pine weevil, *Pissodes strobi* (Peck).** USDA For. Serv. Res. Pap. NE-318. 4 p.

2464. Zerillo, R. T., and T. M. Odell.
1973. **White pine weevil: A rearing procedure and artificial medium.** J. Econ. Entomol. 66:593-594.

2465. Zerillo, R. T., and J. D. Podgwaite.
1975. **Meet the gypsy moth.** USDA For. Serv. Northeast. For. Exp. Stn. 16 p.

2466. Zube, Ervin H., Hugh C. Davis, and Robert O. Brush.
1971. **Landscape architectural research in environmental forestry: A research program for the northeastern United States.** Am. Soc. Landscape Architect. Found., McLean, Va. 18 p.

INDEX OF SENIOR AND JUNIOR AUTHORS

A

Abbott, Herschel G. 833
Acton, Robert W. 2349
Adams, Carol 2428
Adams, Edward L. 1-5
Alden, William M. 2174
Aldrich, R.C. 874
Alicandri, James F. 6
Allen, Peter H. 1211
Allen, Rufus H., Jr. 7-9
Allison, Richard C. 10
Alperi, Robert W. 77
Amidon, Paul H. 1974
Amman, Gene D. 11
Anderson, Henry W. 229, 1306
Anderson, N. G. 202, 1436
Anderson, R. Bruce 12-16
Andresen, John W. 17, 1275
Anspach, John C. 18
Araman, Philip A. 19-21, 1287
Armson, K. A. 22
Arner, Stanford L. 23
Ashley Marilynn 1873
Aubertin, Gerald M. 24-30, 139, 1088, 2262
Auchmoody, Luther R. 31-42, 504-505
Aurand, D. W. 1317

B

Babcock, Harold M. 1752
Bailey, R. Wayne 2204
Baker, Gregory 2298
Banks, Wayne G. 43, 44
Barger, Jack H. 45-55, 364
Barlow, Roger 56
Barnard, Joseph E. 57-66, 169, 609, 610, 655, 1062, 2387, 2388
Barnhisel, R. I. 1427
Barrett, James P. 1211, 1690
Batch, Donald L. 200
Bate, L. C. 67
Bauer, Curtis H. 68
Baughman, Roger N. 69
Baumgras, John E. 70-74
Bay, Roger R. 75
Beall, F. C. 76
Bean, Allan 77
Bean, James L. 78
Bearce, Bradford C. 1744, 1745, 1935, 1936
Beardsley, Wendell G. 79
Beaton, John A. 81, 82, 106-108
Beaton, J. D. 80
Beck Donald E. 1272
Beers, Thomas W. 1392
Behrend, Donald F. 83, 1588
Bell, Susan 1870
Bender, Frederick W. 461, 462, 473, 994
Bennett, H. D. 84
Bent, John E. 85
Benzie, John W. 86
Berg, William A. 87-92, 1429, 2289, 2290
Bergey, Hans T. 93
Berglund, John V. 1185, 1192, 1193, 1233, 1234
Berry, Frederick H. 82, 94-111, 893
Berry, Larry A. 1881, 1882
Berry, Paul 2042
Bertolin, G. E. 887
Bevins, Malcolm I. 112, 113, 1104
Bey, Calvin F. 1273
Beyer, Frank K. 1211
Biazak, Cynthia E. 252
Bickford, C. Allen 58, 613
Biller, Cleveland J. 114-125, 703-705, 1007, 1008, 1695, 2369
Binotto, A. P. 1484
Bird J. 1904
Bishop, D. M. 1439
Bjorkbom, John C. 126-134, 602, 969, 1394, 1395
Bjugstad, A. J. 135, 2291
Black, Peter E. 136, 137
Black, T. A. 2188
Blanchard, R. 1324
Blanchette, Robert A. 138
Blevins, R. L. 139, 140
Blum, Barton M. 141-157, 697, 1095-1097, 2113
Blyth, James E. 158, 159, 170-172
Bolinger, J. W. 160
Bond, Robert S. 161-165
Bones, James T. 158, 159, 166-191
Bonner, F. T. 192
Boone, B. A. 1184
Bormann, F. Herbert 193-196, 915, 1009, 1010, 1246-1248, 1703, 1704
Bourne, Carol E. 1947, 1948
Bowen, David K. 197
Bowers, Teresa M. 59-64, 173, 436
Boyce, Stephen G. 198, 1594, 1728
Brackley, Allen M. 199
Brandt, Robert W. 2053
Branson, Branley A. 200
Brantley, J. N. 202
Brasier, C. M. 201
Breillatt, J. P. 202, 1436
Brett, C. P. 203
Bretz, T. W. 109
Brinkman, Kenneth A. 2348
Brisbin, Robert L. 204-208, 520, 1483, 1484, 1601
Brock, Samuel M. 209, 895
Brodie, John E. 210
Brown, T. L. 113
Bruchet, G. 802
Bruckel, D. W. 211
Brush, Robert O. 212-216, 2192, 2466
Buchanan, Mary 923
Buck, John D. 327
Buckner, C. H. 217
Burdekin, D. A. 218
Burger, D. 597
Burns, Denver, P. 219-228, 482-485
Burton, D. H. 229
Burton, J. D. 1729
Byars, E. F. 648
Byrne, Kevin J. 230

C

Callahan, John C. 231
Campbell, John 30, 1643, 1644
Campbell, Robert W. 232-256, 1490, 1733, 1734, 2273
Cannon, William N., Jr. 257-259, 365, 1035, 1036, 2133, 2134
Capp, John P. 1730
Carl, Clayton, M., Jr. 260-265, 2450-2453
Carlaw, James B. 698
Carlson, Tony C. 266, 267
Carmean, Willard H. 268-270, 1746
Carpenter, B.E., Jr. 271
Carpenter, Roswell D. 198, 272-276
Carroll, David 2043
Carroll, W.J. 277
Carvell, Kenneth L. 278, 1076
Case, James M. 1073
Catron, Leathern, R.R. 1288
Cech, Franklin C. 279, 2366, 2367
Champagne, E. Garth 280
Chang, C. 1349
Chang, W.M. 425, 689
Chapelle, D.F. 281
Chapman, Roger C. 282, 2183
Chase, Thomas 2190
Chatterji, Sujit, K. 509, 510
Chien, Millie 1128-1130
Christensen, W.W. 883
Church, Thomas W., Jr. 283-297, 1499, 2214
Clark, F. Bryan 270, 298-300, 1347, 1879
Clark, K.A. 1377
Clark, Roger N. 301
Clausen, Knud E. 302
Cliff, Edward P. 303
Cobb, Marcia 1323
Cochran, Patric H. 1193
Cole, Gerald L. 113, 304, 1104
Cole, William D. 362
Coleman, Ronald E. 305
Collins, D.L. 306
Collins, E.B. 307
Collins, William H. 308
Conklin, James G. 309
Conner, R.N. 310
Connola, Donald P. 311, 1240
Constantinidou, H. 312
Corbett, Edward S. 313-320, 438, 1315-1317, 1488, 1498

Corcoran, T. 1698
Core, Earl L. 321-324
Core, H.A. 1174
Cormier, Alan D. 1164
Cormier, Paula L. 1164, 1165
Cosenza, Benjamin J. 325-327, 1735-1737, 2055, 2135
Cowan, R.L. 328
Cowling, E.B. 329, 2061
Craft, E. Paul 330-333, 345-347, 1402
Craul, Philip J. 1234, 1588
Crawford, Hewlette, S. 310, 334-336, 900
Creech, John L. 337
Cromer, Jack I. 338, 339
Crossley, John A. 192, 340-342
Cunningham, Richard A. 1193
Cunningham, W. 1324
Cuppett, Donald G. 343-348
Curtis, Robert O. 1746
Curtis, Willie R. 7, 349-363, 1901
Cusumano, Vincent 1771
Cuthbert, R.A. 49-51, 364-367, 1664, 1665, 1672, 1673
Cutter, E. 1485
Czapowskyj, Miroslaw M. 368-383

D

Daft, M.J. 384
Dale, Martin E. 385-388, 1443
Darrach, Alfred 389
Davenport, O.M. 390, 2316
Daviault, L. 1241
Davidson, A.G. 391
Davidson, Ralph H. 52, 225
Davidson, Walter H. 392-399, 408, 2126
Davis, Donald D. 400
Davis, Grant 396, 401-408, 978
Davis, Hugh C. 409, 2466
Dawson, David H. 397
DeBald, Paul S. 410-414, 656-659, 1253, 1339, 1443
DeGraaf, Richard M. 415-422, 723, 1428, 1655, 2192-2195
Deiss, Daniel H. 529
Della-Bianca, Lino 1272
DeMars, C.J. 423, 2322, 2323
Demeritt, Maurice E., Jr. 424-428, 688, 689, 1282
Dempsey, Gilbert P. 429-433, 539, 2418
Despard, Thomas L. 434
Dessureault, M. 435
Dickerson, W.H. 2218
Dickson, David R. 174-183, 436, 1063-1065
Dirr, Michael A. 437
Dissmeyer, George E. 438
Dixon, Ronald A. 2196-2198
Dochinger, Leon S. 329, 439-473, 614, 864, 894, 995-997, 1838a, 1908, 1941, 2101, 2102, 2217, 2386
Dodd, Steven J. 474
Doerner, Robert C. 614
Dolby, A.J. 475
Donley, David E. 226, 227, 476-487, 852, 853
Donnelly, John R. 261, 488-491
Donohoe, Robert W. 492, 493, 1603
Doolittle, Warren T. 494-503, 1255, 1975, 1976
Dorn, Donald E. 504-506
Dorrell, Frederick A. 507
Doshi, Yobesh K. 508
Doskotch, Raymond W. 509, 510
Doughty, Richard M. 1126
Douglass, James E. 511
Drnevich, V.P. 512, 513
Drooz, A.T. 514
Dubois, Normand R. 515-517, 1242, 1472
Duchacek, Howard 671
Duda, Edward J. 252
Dudley, Theodore R. 518
Duffield, J.W. 1222
Duggans, W.E. 1174
Duke, Theodore, J. 1449
Dunmire, Daniel E. 519, 520

E

Eabry, Steve 521
Eads, Larry D. 522, 523
Eaton, John S. 193, 196, 914
Ebelhar, R.J. 512, 513
Echelberger, Herbert E. 524-534, 1344, 1463, 1588, 2380, 2381
Eckert, Phillip L. 1393
Egolf, Donald R. 535
Ellefson, Paul V. 536-540
Elliott, K.C. 160, 307, 706, 1283
Ellis, R.C. 541
Emanuel, David M. 348, 542, 543
Engalichev, N. 184
Engelken, John H. 1464-1466
Eno, Harold G. 946
Escheman, Robert T. 1274
Eschner, Arthur R. 544-547, 1193, 1228, 1229, 1787
Essex, Burton L. 660

F

Fabos, Julius Gy 548
Farr, W. A. 1439
Fay, Stephen 549, 550
Federer, C. Anthony 77, 551-576, 687, 909-911, 918, 1230, 1231, 2188
Fedkiw, John 1422
Fedorko, M. R. 1904
Ferguson, Roland H. 577-582
Ferrigan, James J. 807, 808
Ffolliott, Peter F. 583
Filip, Gregory M. 584
Filip, Stanley M. 39, 585-593, 1212-1214, 1220, 1871, 2049
Finley, James C. 1066
Finnegan, R. J. 594, 2346
Fisher, D. W. 194, 195, 1009, 1247
Fisher, Edward G. 1166
Fisher, Edward L. 595
Fisk, Frank W. 1666, 1667
Flaherty, Donald L. 956
Flake, R. H. 2393
Fleischer, H. O. 1033
Flemer, William III 596
Flick, Virgil 506
Foley, G. E. 1184
Fortescue, J. A. C. 597
Foulds, Raymond T. 1134
Fowler, M. E. 391
Fox, F. L. 462
Frame, Robert E. 1798
Frank, L. D. 1772
Frank, O. Lynn 1491
Frank, Robert M. 134, 378, 598-604, 1872
Franklin, J. E. 202
Frayer, H. C. 43
Frayer, Warren E. 605-613
Freeman, Wilfred L., Jr. 614
Fridley, Burley D. 1645
Fridich, James H. 615
Frost, Richard E. 616, 1175
Fulton, John R. 617
Furnival, George M. 611, 612, 618, 619
Fusillo, T. 1498

G

Gabriel, William J. 620-635, 1098, 1109, 1110, 1588, 1595, 2317, 2368
Gagnon, J. D. 636
Gale, Ronald 520
Galford, Jimmy R. 486, 637-646, 1044, 1045
Galoch, E. 647, 759, 1450, 1451
Gambrell, S. C., Jr. 648
Gammon, Glenn L. 649, 650, 1765
Gannon, Richard C. 1656
Gansner, David A. 410, 651-665, 1176-1179, 2003
Gardescu, Paul 666
Garrett, David 667
Garrett, Lawrence D. 294, 668-671, 1677-1682
Garrett, Peter W. 302, 672-680, 1050
Garrett, Wallace T. 2184
Gartner, J. B. 1431
Gatchell, Charles J. 681-686, 1289, 1449, 1485, 1813-1816
Gatherum, Gordon E. 998
Gatslick, Harold B. 1583
Gee, Glendon W. 569-572, 687
Gerhold, Henry D. 400, 425 426, 688-691, 1282, 2138
Getty, Russell E. 1986, 1987

Gibbs, Carter B. 152, 692-701, 1096, 1097, 1476, 2074-2079, 2109
Gibbs, J. N. 201
Gibson, Harry G. 595, 702-711, 839, 840, 1611
Gibson, Lester P. 228, 712-722
Giese, R. L. 1284, 1358, 1359
Gill, John D. 328, 723-736, 859, 1076, 1744, 1745, 1883, 2104, 2199, 2204, 2205, 2246, 2438
Gillespie, William H. 737
Gingrich, Samuel F. 655, 738-743, 1457, 1835, 1836
Gladstone, William T. 744
Glover, Ralph P., Jr. 745
Gochenour, Donald L., Jr. 707, 709, 746-749, 1008
Godman, Richard M. 295, 750
Godwin, Paul A. 594, 751, 752, 842, 1591
Goetz, Ellen J. 860, 861
Goho, Curtis D. 753-755, 2448
Goodhue, Sargent 756
Gooley, Walter R., Jr. 1760
Gordon, Barry 757
Gore, William E. 230, 758, 1665, 1671-1673
Gorska-Brylass, A. 759
Goswami, Niranjan 1646
Gouin, Francis R. 760
Gould, Ernest M. 1647
Gove, James P. 761, 762, 970
Graber, Raymond E. 763-773, 1215-1217
Gove, W. G. 184
Gray, Richard L. 744
Gregory, Garold F. 774-787, 1017, 1018, 1367-1369
Gregory, Robert A. 788-791, 1848
Grimble, David 1242
Grimes, J. L. 328
Grisez, T. J. 792-798, 1394, 1444
Gross, H. R., Jr. 1245
Gunner, Haim B. 1472

H

Haaland, A. C. 1167
Hacskaylo, Edward 384, 799-803, 1440, 2293
Hadley, Lawrence C. 804
Hafley, W. L. 805, 824
Hagenstein, Perry R. 806
Hager, E. R. 970
Hajny, George J. 807, 808
Halverson, Howard G. 2098
Hamilton, George T. 1164
Hamilton, J. E. 888
Hamilton, John F., Jr. 809, 1977-1979
Hamilton, J. R. 810
Hamilton, Tom S., Jr. 811, 812
Hamlen, Ronald A. 2457
Hammack, K. P. 40, 2084
Hanks, Leland F. 813-821, 1932
Hanks, Sidney 822
Hannah, Peter R. 270
Hanover, J. W. 823, 2392, 2393
Hanover, S. J. 824
Hansen, Bruce G. 745, 825-830, 1281
Hansen, K. W. 805
Harlow, R. F. 335
Harper, D. O. 831
Hart, Arthur C. 832, 833, 2298, 2299
Hart, George E. 834, 835
Hart, Irving A. 836
Hart, James B., Jr. 1193
Hartley, Brent, A. 837
Hartman, Robert L. 122-124, 707-709, 747, 748, 838-841, 1696
Hastings, A. R. 842, 1243
Hay, Cyrus John 485, 486, 843-854, 2117
Heagy, James F. 855
Healy, William M. 724, 725, 735, 856-863, 1883, 2199, 2205
Heaton, George C. 2428
Heck, Walter W. 462, 463, 864
Heebink, B. G. 1244
Heilman, John M. 316
Heinselman, Miron L. 865
Heisler, Gordon M. 866-868, 886, 888, 1773
Hejnowicz, Zygmunt 869-873
Heller, R. C. 874
Helrich, Kenneth 53, 54
Hendee, John C. 875
Henderson, James E. 2458, 2459
Henderson, Morris R. 1120
Hennessey, Gerard J. 1183
Hepting, George H. 876
Herrick, Owen W. 661, 662, 877-884
Herrington, Lee P. 868, 885-888, 1232
Herrington, Roscoe B. 1237
Hess, W. R. 1437
Hetherington, John W. 889
Hewlett, John D. 890
Heybroek, Hans M. 218, 891
Hill, Stuart B. 2352
Hillis, W. E. 2044
Himelick, E. B. 892
Hock, Kenneth J. 113, 1104
Hock, Winant K. 55, 110, 893, 894
Hocker, H. W., Jr. 427
Hogan, William G. 209, 895
Holland, I. I. 896
Holowaychuk, N. 139, 140
Holt, Fred E. 44
Holt, William R. 897, 898, 2133, 2134
Holweg, Arthur W. 899
Homeyer, J. W. 2263
Hooper, Robert G. 335, 900
Hopkins, Richard D. 2301
Hopkins, Walter S. 901, 902, 1168
Hornbeck, James W. 574, 903-922, 1418, 1703
Horowitz, Sylvia 923
Hosier, Paul E. 924, 925
Hough, Ashbel, F. 926, 2405
Houston, David R. 927-946, 1623, 2332-2334
Hoyle, Merrill C. 584, 761, 762, 957-970
Howe, E. E. 633
Howe, George E. 947, 948
Hoy, Marjorie A. 949-956
Hubbard, David L. 250, 251
Hubbard, Harry B., Jr. 971, 1844
Hughes, Jay M. 972
Hughes, T. D. 1431
Huguely, Juanita 1121, 1122
Hungund, Basalingappa L. 973
Huntzinger, Harold J. 974-977
Hutnik, Russell J. 978, 1315
Huyler, Neil K. 979, 980, 1403

I

Irish, H. Jack 1589
Irland, Lloyd C. 1656

J

Jackson, Lawrence W. 981
James, George A. 982
James, L. M. 1376
Jensen, Keith F. 312, 464, 465, 780, 983-1006, 1817, 1818, 1837, 1838
Johnson, Edward P. 211, 2454
Johnson, Leonard R. 125, 749, 1007, 1008
Johnson, Noye M. 1009, 1010, 1246-1248
Johnson, Roy R. 1011, 1778, 2125
Jones, Jerry K. 1012
Jones, R. R. 1802, 1805a
Jones, Richard L. 1245
Jones, Thomas W. 781-784, 786, 1013-1019, 1799-1802
Jordan, James S. 328, 1020-1032
Jordan, Peter A. 2097
Jorgensen, Richard N. 807, 808, 1033
Jouvenaz, D.P. 1034
Jumper, Gene A. 1035, 1036

K

Kallio, E. 896
Kardos, Louis T. 1037, 1820, 2120, 2121
Keiser, George M. 1038, 1039, 2080, 2081
Kelso, Elmer G. 1040
KenKnight, Glenn E. 1947
Kennedy, Bruce H. 366, 898, 1041-1046, 1667
Kennell, Richard A. 2245

Ketchledge, Edwin H. 1047-1049
Kettlewood, Harry C. 428, 677, 679
Kiang, Y.T. 1050
Kidd, W.J. 1051
Kilham, Lawrence 2045
Kimmel, Richard O. 861
Kingsley, Neal P. 185, 186, 579, 1052-1067
Klawitter, Ralph A. 1068-1073, 2458, 2459
Klein, William H. 1074
Kleiner, Gail F. 1075
Knierim, Philip G. 1076
Knight, P. B. 1077
Knutson, Robert G. 1078-1081
Kochenderfer, James N. 1051, 1082-1090, 2246, 2262, 2369
Koelling, Melvin R. 153-155, 1091-1098
Koenick, Leonard J. 1099, 1404
Konar, R. N. 1100, 1101
Kopcewicz, J. 1102, 1103
Kottke, Marvin W. 1104
Kozlowski, T. T. 312, 999-1001, 1105
Krammes, J. S. 75
Krause, Charles R. 1803, 1804, 2401
Krause, H. H. 1106
Krawczyszyn, J. 1107, 1108
Kreisel, K. 1111
Kriebel, Howard B. 634, 1109, 1110
Krochmal, Arnold 156, 1112-1130
Krugman, S. L. 1131

L

Ladd, Edward R. 833
Laing, Frederick M. 671, 1134, 2046, 2092
Lambrix, Thomas G. 757
Lamore, Richard J. 2082
Lamparska, K. 1452
Lamson, Neil I. 1132, 2083
Lancaster, Kenneth F. 1133, 1134
Lane, Richard D. 1135-1138
Lanier, G. N. 1139, 1665, 1672, 1673
LaPage, Wilbur F. 113, 902, 1104, 1140-1173
Large, Hollis, R. 616, 1174, 1175
Larrson, L. Cedric 634
Larrson, H. C. 1110
Larsen, David N. 662, 663, 1176-1179
Larson, Edwin vH. 1180, 1181, 1899, 1930, 2047, 2048
Larson, Joseph S. 416, 1182
Larson, Rodney G. 1467
Lautenschlager, R. A. 1183
Lautz, William 111
Lazarus, H. 1184
Leaf, Albert L. 545, 1185-1194, 1233, 1234, 2175
Leak, William B. 590, 771, 1195-1220, 1690, 1854, 1907, 2049, 2114
Lederer, Robert F. 1221
Ledig, F. T. 1222
Lee, R. 1089
Lemmien, W. A. 1376
Leonard, David E. 1223
Leonard, Raymond E. 136, 137, 531, 544, 545, 550, 573, 887, 888, 1048, 1049, 1185-1194, 1224-1235, 1819, 2175
LeQuesne, P.W. 1123
Leroy, J.C. 1184
Lessard, Ronald A. 2066
Lesser, Walter A. 1236
Letourneau, Larry 65
Leuschner, William A. 1237
Lewis, Franklin B. 311, 325, 971, 1074, 1238-1243, 1844, 1845, 2457
Lewis, W.C. 1244
Lewis, W.J. 1245
Likens, Gene E. 193-196, 912, 915, 919, 1009, 1010, 1246-1248, 1703, 1704
Lime, David W. 1249
Lincoln, A. Charles 364, 366, 1250-1252, 1668-1670
Lindmark, Ronald D. 1253, 1753, 1754
Liscinsky, Stephen A. 1254, 1980
Little, Elbert L., Jr. 591, 1255, 1872
Little, Silas 86, 1255-1279
Lockyer, James W. 1805
Lloyd, Duane R. 1280
Lohr, Chauncey J. 187, 1281
Long, A.J. 688, 1282
Longhouse, A.D. 160, 1283
Lowe, J.H., Jr. 874
Lowe, R.E. 1284
Lucas, Edwin L. 21, 685, 1285-1289
Lucas, John T. 1290-1294
Lucas, Robert C. 1295
Lull, Howard W. 890, 1296-1314, 1371, 1788, 2122-2124
Lynch, James A. 317-319, 1315-1317
Lyon, W.S. 67

M

MacCollom, G.B. 1318
MacConnell, William P. 1319-1327
MacLachlan, Robert 1468
McCauley, Orris D. 1328-1335, 2382
McCay, Roger, E. 411, 1336-1342, 1660
McClung, Lester 2240, 2241
McComb, Charles W. 2184
McConaughy, Daniel 1273
McConkey, Thomas W. 1343
McCormick, Jack 1275
McCreary, Mathilda 327
McCurdy, Dwight R. 1344
McDaniel, O.H. 1772
McDermott, R.E. 690
McDonald, Clark E. 1345
McDonough, J.L. 311
McElwee, R.L. 1346
McGee, Charles E. 1347, 2242
McGinnes, Burd S. 900
McGinnes, E.A., Jr. 1348-1353, 2447
McIntyre, Thomas 1354
McLane, W.H. 1770
McManus, Michael L. 1284, 1355-1360
McNamara, Eugene F. 1366
McNichols, Robert R. 1660
McQuilkin, William E. 379, 1361-1366
McWain, Percy 783-786, 1018, 1367-1369
Mader, Donald L. 546, 1211, 1370, 1371
Maeglin, Robert R. 2298, 2299
Magee, Karyl 1124
Manthy, Robert S. 1372-1376, 1487, 2243
Marburger, Rodney, G. 1377, 2200-2202, 2206, 2207
Marion, Giles M. 1193
Markeson, Clyde B. 433
Marlatt, Daniel L. 1589
Marquis, David A. 8, 750, 1328, 1378-1395
Marquis, Ralph W. 1396
Martell, Arthur M. 1397
Martens, David G. 1398-1404
Martignoni, M.E. 202
Martin, A. Jeff 754, 1405-1417
Martin, C. Wayne 919, 920. 1218, 1418, 1704
Marton, Ranata 1419
Marty, Robert 1420-1423
Marvin, David R. 1424
Marvin, James W. 671
Marx, Hal 1425
Massey, H.F. 1426-1427
Masters, Roberta G. 994, 1002, 1003
Maunder, Elwood R. 1930
Maurice, Steven C. 1165
Mawson, Joseph C. 1211, 1428, 2195
Maxwell, G. 1222
May, Robert F. 90, 1429, 1430, 2171
Mayer, Carl E. 58, 66, 188, 580-582. 1067
Mazur, A.R. 1431
Mazzone, H.M. 202, 1184, 1432-1437
Meadows, John C., Jr. 1438, 1933, 2351
Meehan, W.R. 1439
Melhuish, J.H., Jr. 1440
Mendel, Joseph J. 412-414, 797, 1329, 1441-1446, 2244, 2245
Mergen, Francois 1276
Metterhouse, W. 1242

Michalski, Leszek 1447, 1448
Michie, Jarvis D. 686, 1449
Michniewicz, M. 647, 1111, 1450-1452
Mietz, James 1981, 1982
Mikhail, Adel A. 510
Mikulecky, John P. 380
Miles, Vernal C. 1683
Miller, Marilyn G. 252
Miller, William C. 15, 1453-1455, 2159, 2160
Millers, I. 1456
Minckler, Leon S. 1457
Moeller, George H. 530, 531, 1340, 1341, 1458-1470, 1475, 1824, 1853, 1983-1987, 2246
Mohr, John J. 1277
Mook, Paul V. 1277, 1471
Moore, Gary S. 1472
More, Thomas A. 216, 1473
Morgan, James T. 1755
Morris, R.C. 854
Morris, R.F. 1474
Morrison, Douglas A. 529, 1467-1469, 1475, 1987, 1988
Morrow, Robert R. 1476
Morse, J. Edwin 884
Morselli, Mariafranca 1955
Moser, Harold C. 1477
Mott, Gordon G. 1478-1481
Mount, Peter R. 1482
Muldrew, J.A. 2267
Mullin, A.G. 824
Murphey, Wayne K. 206, 1483-1485
Murphy, J.D. 425
Myklestad, Erik 1486

N

Nagle, George S. 1487
Nathan, K. 1488
Nation, J.L. 1821, 1822
Neely, Dan 1489
Neely, Robert D. 1490, 1738
Nelson, James C. 1491
Nelson, Thomas C. 1492
Nelson, William R., Jr. 1493
Nevel, Robert L., Jr. 1494-1496
Newby, Floyd L. 1497
Newton, Carlton M. 2271
Niedzwiedz, William 1325, 1326
Nieswand, G.H. 1488, 1498
Ningard, Louis G. 1777
Niskala, George R. 296, 1499
Nisson, R.L., Jr. 1588
Nixon, Charles M. 1500, 2442
Nolet, Richard J. 2115
Nolley, Jean W. 210, 1281, 1501-1508, 2419
Norcott, Kendall S. 1509
Nordlund, Donald A. 1245
Northeastern Forest Experiment Station 1510-1582
Norton, Kenneth 1583
Noyes, John H. 1584, 1585
Nyland, Ralph D. 1586—1589

O

ODell, Thomas M. 751, 1590-1593, 2464
Olson, David F., Jr. 1594, 1595
Orr, Howard R. 1596
Ostrander, Myron D. 1597-1601

P

Pack, James C. 735, 1602, 1603, 1883, 2199, 2203-2205
Palpant, E.H. 426, 689
Pan, I.C. 1437
Parencia, C.R., Jr. 1604
Parker, Homer 707, 709, 1605-1611
Parker, Johnson 1612-1624, 2334
Parr, Sally B. 1235
Pathak, Chandravadan H. 973
Patric, James H. 27-29, 69, 1090, 1439, 1625-1651, 2099, 2246, 2439, 2440
Patterson, James C. 1652
Patton, Roy L. 1624
Pawlow, J.R. 1488
Payne, Brian R. 417, 1653-1660
Peace, Maurice R. 798
Peacock, John W. 365, 367, 509, 645, 898, 1075, 1139, 1661-1670, 1672, 1673, 1909
Pearce, Glenn T. 230, 758, 1665, 167-1673
Pearce, John W. 297
Peckham, David J. 1674
Peirsol, Margaret K. 820
Pendleton, Thomas H. 209, 829, 1675-1682, 1934
Pennock, Rogert [Roger], Jr. 1683
Perrin, R.K. 824
Perrson, S.P.E. 706
Peters, Robert C. 613, 1684-1689, 2406-2409
Phelps, J.E. 1350
Phelps, William R. 1019
Philbrook, James S. 1690
Phillips, James D. 2264
Phillips, John J. 1691, 1692
Phillips, Ross A. 710, 711, 841, 1611, 1693-1697, 2105
Phillips, W. 1698
Pierce, Robert S. 194-196, 574, 911, 915-920, 1009, 1010, 1247, 1248, 1699-1704
Pierson, George H. 189
Pinchot Institute 1705
Plass, William T. 9, 1706-1731, 2208, 2376
Podgwaite, John D. 253, 326, 1732-1738, 1769, 2465
Pogge, Franz L. 726-733, 1739-1745
Porazinski, Z. 759, 1102, 1103
Porter, I.R. 336
Post, Boyd W. 261, 972, 1746
Pottle, William H. 1747, 1748
Prausa, Robert L. 1749
Progulske, Donald R. 1585
Putnam, Eugene L. 603
Pywell, H. Ross 418, 1327
Pywell, Nancy Arny 1326

Q

Quigley, Kenneth L. 896, 1750-1755
Quimby, J. 1242

R

Radtke, Robert E. 737
Ragain, Dale P. 1169-1173
Ramirez, Miguel A. 2387, 2388
Rammrath, Rita M. 1756-1760, 1989
Rast, Everette D. 1761-1765
Rauschenberger, J.L. 1766
Rauter, R.M. 678
Rawson, James W. 1767
Reardon, Richard C. 1768-1770, 1861
Redett, Robert B. 190, 2446
Redman, John C. 1330, 1784
Reed, P.A. 364
Reeks, W.A. 752, 2383-2385
Reethof, Gerhard 1772, 1773
Reeves, Calvin C. 1704
Rennie, Peter J. 1789
Reigner, Irvin C. 1307, 1774-1778, 2125, 2167
Reinhart, Kenneth G. 890, 1308-1310, 1648, 1683, 1779-1788
Rex, Edgar G. 1790
Rexrode, Charles O. 1791-1805a
Reynolds, Hugh W. 305, 1806-1816
Reynolds, Phillip E. 1004, 1005, 1817, 1818
Rhodes, Arnold D. 1887
Rich, Avery E. 435, 584, 615
Richards, Norman A. 1194, 1819
Richards, Thomas A. 1990
Richenderfer, James L. 1820
Richeson, J.S. 1821, 1822
Riddle, Jane 1323, 1824
Rier, John P. 1825, 1826
Riley, L.F. 229
Rindt, Charles 1422
Rink, George 2208
Roach, Benjamin A. 1393, 1394, 1491, 1827-1836, 2348
Roberts, Bruce R. 997, 1006, 1837-1838a
Roberto, H.H. 50
Roberto, Nick H. 366, 1046
Robertson, Dana 1326
Robinette, Sadie L. 862, 1839-1841
Robinson, R.M. 1377, 2206, 2207
Rogers, Robert 1842
Rollins, James A. 1843

Rollinson, William D. 1592, 1844, 1845
Romberger, John A. 789-791, 872, 1108, 1846-1851
Rosier, Robert L. 2084, 2247
Ross, Robert S. 1852
Ross, Terence L. 1853
Rourke, R.V. 378
Rozej, B. 1451, 1452
Rudolf, Paul O. 1854
Rudolph, Victor J. 1376, 1416
Rushmore, Francis M. 1031, 1855-1857
Russell, T.E. 1858
Rutherford, William, Jr. 1859, 1991
Ryan, John J. 1860
Rye, Arthur H. 2085

S

Sabrosky, Curtis W. 1861
Safford, Lawrence O. 604, 1862-1874, 2168
Sailer, R.I. 1875
Samuels, George 1125
Sander, Ivan L. 1876-1879
Sanderson, H. Reed 735, 1603, 1880-1883, 2199, 2205
Santamour, Frank S., Jr. 1884-1887, 2278
Sardo, William H., Jr. 1888
Sarles, Raymond L. 1889-1899
Sartz, Richard S. 1900, 1901
Satterlund, D.R. 547
Saunders, Henry W. 1902
Schemnitz, Sanford D. 1903
Schmidt, Elizabeth A. 1978, 1979
Schmidt, J.W. 1904
Schmidt, Robert A. 1905, 2429
Schmitt, Daniel M. 1131, 1906
Schopmeyer, C.S. 1907
Schreiber, Lawrence R. 646, 1908, 1909
Schreiner, Ernst J. 679, 690, 1419, 1910-1929
Schrepfer, Susan R. 1930
Schroeder, James G. 271, 1931, 1932
Schuler, Albert T. 1438, 1933
Schuster, Ervin G. 1934
Scott, Eion G. 1935, 1936
Seegrist, Donald W. 51, 472, 473, 635, 664, 1937-1940, 2248, 2249
Seliga, Thomas A. 466-469, 1941
Seliskar, Carl E. 470, 787, 1942-1948, 2400, 2401
Sendak, Paul E. 16, 164, 1417, 1949-1955
Severinghaus, C.W. 1974
Shafer, Elwood L., Jr. 532-534, 1470, 1859, 1956-1993, 2060
Sharon, Edward M. 138, 1994-1998, 2050-2053
Sharp, Ward M. 1032, 1999, 2000
Shaudys, Edgar T. 665
Shaw, Samuel P. 2001-2003
Shea, Patrick J. 2394
Shelton, T. 1498
Sherwood, John K., Jr. 191
Shields, Kathleen Stone 2004
Shigo, Alex 2054
Shigo, Alex L. 327, 435, 584, 615, 876, 1351, 1352, 1747, 1748, 1825, 1826, 1873, 1998, 2005-2059, 2062, 2066, 2092, 2116, 2135, 2189, 2190, 2402, 2403
Shiner, James William 2060
Shirley, N.D. 592
Shogren, Paul W., Jr. 1683
Shope, R.E. 1437
Shortle, Walter C. 2061, 2062
Shottafor, J.E. 2063, 2180
Shull, Kenneth E. 2064
Shutts, Lynn M. 2065
Siccama, T.G. 196
Silverstein, Robert M. 230, 758, 1139, 1665, 1668-1673
Simeone, John B. 1668-1670, 1672, 1673
Simmons, G. 1698
Simons, H.P. 831, 2358
Skratt, Thomas A. 2185, 2186
Skutt, H. Richard 2066, 2335
Sloan, Ronald J. 250-252, 254
Smith, H. Clay 41, 339, 699, 700, 2067-2094, 2250, 2251, 2318-2320
Smith, David W. 29, 1649
Smith, E. Frank 900
Smith, Hanley K. 2095
Smith, Harvey R. 1360, 2096, 2097
Smith, James L. 2098
Smith, Joseph H. 2099
Smith, Robert L. 2100
Smith, William H. 471, 1445, 1817, 1818, 1824, 2101, 2102
Smithberg, Margaret 2103, 2104
Smithson, Paul M. 2086, 2105
Snow, Albert G., Jr. 262, 701, 2087-2090, 2106-2109
Solomon, Dale S. 157, 1214, 1219, 1220, 1395, 2110-2117
Solomon, J.C. 2117
Somes, Horace A. 1278, 1279
Sonderman, David L. 207, 208, 1765, 2118, 2119
Sopper, William E. 317-319, 1037, 1311-1314, 1316, 1317, 1778, 1820, 2120-2125
Sowa, Edward A. 380-382, 398 399, 2126
Spencer, Bruce A. 2127
Spencer, Warren 320
Spoerke, G.R. 76
Spomer, Arthur L. 2128-2131
Spray, Richard A. 1697
Squires, Alan H. 517
Staley, David H. 2133, 2134
Stairs, Gordon R. 1419, 2132
Standaert, Joseph P. 255
Stankewich, Joseph 2055, 2135
Stankey, George H. 1249
Stark, R.W. 2136
Statler, W.W. 1770
Stearns, Forest W. 2137
Stein, W.I. 1131
Steiner, Kim C. 691, 2138
Steinhagen, Hans-Peter 2139
Stern, E. George 1099, 2140-2164, 2303-2306
Stern, K. 2279
Stipes, R.J. 2165
Stone, Earl L. 2166
Stone, G.L. 2056
Storey, Herbert C. 2167
Stratton, K.G. 2168
Striffler, David W. 1430, 2169-2171
Strobel, John J. 2172, 2173, 2306
Strom, Steven 1657
Struchtemeyer, R.A. 2168
Stuart, Gordon 921, 2174
Studenmund, W.R. 1650
Stutzbach, Stephen J. 2175
Sutton, R.F. 86
Swan, J.B. 2188
Swank, Wayne, T. 438, 511
Swanson, Carl W. 821
Swett, Charles E. 1343, 2176
Swingle, R.U. 2177

T

Tabor, C.A. 1849-1851, 2178, 2179
Tabor, David W. 199, 2180
Talerico, Robert L. 11, 1766, 2181-2187, 2274
Tanner, C.B. 575, 576, 2188
Tattar, Terry A. 2189, 2190
Tegeler, H. 1184
Thirgood, J.V. 2191
Thomas, Jack Ward 418-422, 723, 734, 735, 863, 1377, 1428, 1602, 1658, 1659, 1883, 2192-2207
Thompson, Donald F. 771-773
Thompson, Roger C. 1992
Thor, Eyvind 2208
Thorner, Benjamin C. 30
Tignor, G.H. 1437
Timson, Floyd G. 2209-2214
Tolsted, David N. 363
Tombaugh, Larry W. 2215
Tompkins, C.M. 803
Tooby, Michael 1993
Torlone, W.D. 1904
Townsend, Alden M. 472, 473, 997, 1838a, 2216, 2217
Trent, Roy E. 2218
Trimble, George R., Jr. 1331, 1332, 1423, 1444, 1446, 1651, 1787, 2091, 2219-2258, 2265, 2370, 2455
Troendle, Charles A. 922, 2259 2264

True, R.P. 1805a
Tryon, E.H. 2252-2257, 2265
Tubbs, Carl H. 2266
Turnock, W.J. 2267

U

Uebler, R. 1588
Uleck, Ronald B. 2268
U.S. Forest Service 2269-2272

V

Valentine, Harry T. 256, 2273, 2274
van Buijtenen, J.P. 2275-2279
van Dyne, G.M. 2280
van Hoozer, Calvin 2202
van Lear, David H. 1130, 2281
Vilkitis, James R. 2282
Vogel, Willis, G. 91, 92, 135, 1731, 2280, 2283-2291
von Althen, F.W. 541, 2292
von Lindern, Ian H. 1593
Vozzo, J.A. 2293

W

Wachsmuth, E. 1485
Wagar, J. Alan 1486, 2294-2297
Wahlgren, Harold E. 2298, 2299
Walker, E. Bradford 2092
Walker, Vernon J. 900
Wallace, Oliver P. 2300, 2301
Wallin, Walter B. 1292-1294, 1888, 2161-2164, 2172, 2173, 2302-2306
Wallner, W.E. 1456
Walters, Russell S. 390, 635, 1126, 1133, 1134, 2057, 2093, 2094, 2307-2320, 2456
Walton, Gerald S. 664, 1470, 2321-2323
Ward, J.C. 1350
Ward, Wilber 1491
Warder, B.J. 830
Wargo, Philip M. 2324-2335
Wartluft, Jeffrey L. 2336-2342, 2420
Waters, William E. 277, 2343-2346
Watt, K.E.P. 2347
Watt, Richard F. 300, 2348
Wayt, William A. 2349
Webb, Charles D. 2350
Weber F.P. 874
Webster, Henry H. 2351
Weedfall, R.O. 2218
Weetman, Gordon F. 2352
Weidhaas, John A., Jr. 2353
Weigle, Weldon K. 2354-2357
Wells, G.R. 1174
Wen, C.Y. 2358
Wendel, George W. 42, 810, 2258, 2359-2370
Werner, Robert G. 2371
West Virginia Department of Natural Resources 2372
Wheeland, Hoyt A. 2441
Whipkey, Ronald Z. 2373-2375
White, James R. 2376
White, William B. 82, 1342, 1591, 1660
Whittaker, James C. 165, 1333, 1334, 2349, 2377-2382
Whitten, R.R. 2177, 2383-2385
Wiackowski, S.K. 2386
Wiant, Harry V., Jr. 2387, 2388
Wilding, L.P. 140
Wilken, Leon 1127-1130
Wilkins, Bruce T. 304
Wilkinson, Ronald C. 823, 1034. 1821, 1822, 2389-2393
Williams, Carroll B., Jr. 2394
Williams, F.W. 593
Williams, George P., Jr. 512, 513, 2357, 2395, 2396
Williams, J. Richard 1168
Williams, Robert D. 270
Williamson, Malcolm J. 1492, 2397
Williamson, Robert D. 2398, 2399
Wilson, Charles L. 1948, 2058, 2059, 2400-2403
Wilson, Robert K. 1211
Wilson, Robert W., Jr. 612, 613, 618, 619, 1222, 1684-1689, 2187, 2404-2409
Winieski, J.A. 690
Wisdom, Harold W. 540
Wistendahl, Jean D. 1236
Wloch, W. 2410
Wodzicki, Alina B. 2411
Wodzicki, T.J. 2411, 2412, 2462
Wolf, Charles H. 2342, 2413-2420
Wolgast, Leonard J. 2421
Wollerman, Edward H. 67, 2422-2428
Wood, Francis A. 2429
Wood, Gene W. 1683, 2430, 2431
Worley, David P. 259, 487, 583, 736, 1335, 2432-2441
Worley, D. Michael 1500, 2442
Wren, Thomas E. 2443, 2444
Wright, J.W. 2393, 2445
Writer, Ross 383, 2446
Wu, K. Y-t. 1349, 1353, 2447
Wysor, Paul S. 348, 755, 2448

Y

Yawney, Harry W. 263-265, 491, 1318, 2449-2456
Yendol, William G. 2457
Young, Cortland E., Jr. 2458, 2459
Young, Harold E. 1874
Young, Keith K. 1073
Young, Peter E. 1327
Younkin, Paul 1683

Z

Zagórska-Marek, B. 873, 2460
Zahner, Robert 680
Zarnetske, J. 1588
Zatorska, Z. 1451
Zajaczkowski, Stefan 2412, 2461, 2462
Zerillo, Roger T. 1738, 2463-2465
Zube, Ervin H. 2466

☆U.S. GOVERNMENT PRINTING OFFICE: 1980-603-111/21

Horowitz, Sylvia, and Mary DeFusco.
1980. **Publications of the Northeastern Forest Experiment Station 1966-76**. Northeast. For. Exp. Stn., Broomall, Pa.
131 p. (USDA For. Serv. Gen. Tech. Rep. NE-58)

A list, by authors, of 2472 publications by staff members of the Northeastern Forest Experiment Station and their cooperators during the period 1966-76.

945.4(048.1)

Horowitz, Sylvia, and Mary DeFusco.
1980. **Publications of the Northeastern Forest Experiment Station 1966-76**. Northeast. For. Exp. Stn., Broomall, Pa.
131 p. (USDA For. Serv. Gen. Tech. Rep. NE-58)

A list, by authors, of 2472 publications by staff members of the Northeastern Forest Experiment Station and their cooperators during the period 1966-76.

945.4(048.1)

Horowitz, Sylvia, and Mary DeFusco.
1980. **Publications of the Northeastern Forest Experiment Station 1966-76**. Northeast. For. Exp. Stn., Broomall, Pa.
131 p. (USDA For. Serv. Gen. Tech. Rep. NE-58)

A list, by authors, of 2472 publications by staff members of the Northeastern Forest Experiment Station and their cooperators during the period 1966-76.

945.4(048.1)

Horowitz, Sylvia, and Mary DeFusco.
1980. **Publications of the Northeastern Forest Experiment Station 1966-76**. Northeast. For. Exp. Stn., Broomall, Pa.
131 p. (USDA For. Serv. Gen. Tech. Rep. NE-58)

A list, by authors, of 2472 publications by staff members of the Northeastern Forest Experiment Station and their cooperators during the period 1966-76.

945.4(048.1)

Headquarters of the Northeastern Forest Experiment Station are in Broomall, Pa. Field laboratories and research units are maintained at:

- Amherst, Massachusetts, in cooperation with the University of Massachusetts.
- Beltsville, Maryland.
- Berea, Kentucky, in cooperation with Berea College.
- Burlington, Vermont, in cooperation with the University of Vermont.
- Delaware, Ohio.
- Durham, New Hampshire, in cooperation with the University of New Hampshire.
- Hamden, Connecticut, in cooperation with Yale University.
- Kingston, Pennsylvania.
- Morgantown, West Virginia, in cooperation with West Virginia University, Morgantown.
- Orono, Maine, in cooperation with the University of Maine, Orono.
- Parsons, West Virginia.
- Princeton, West Virginia.
- Syracuse, New York, in cooperation with the State University of New York College of Environmental Sciences and Forestry at Syracuse University, Syracuse.
- University Park, Pennsylvania, in cooperation with the Pennsylvania State University.
- Warren, Pennsylvania.

by Howard G. Halverson
Joseph C. Mawson
Brian R. Payne

GOVT. DOCUMENTS
DEPOSITORY ITEM
SEP 15 1980
CLEMSON
LIBRARY

A COMPUTER PROGRAM to Map Tree Crown Shadows in the Urban Forest

CLEMSON UNIVERSITY LIBRARY
SEP 16 1980
SCI. TECH. & AGR. DIV.

FOREST SERVICE GENERAL TECHNICAL REPORT NE-59
1980

FOREST SERVICE, U.S. DEPARTMENT OF AGRICULTURE
NORTHEASTERN FOREST EXPERIMENT STATION
370 REED ROAD, BROOMALL, PA. 19008

The Authors

HOWARD G. HALVERSON is Research Forester and Project Leader with the Northeastern Forest Experiment Station, Forest Amenities and Municipal Watershed Research Project, located at State College, Pennsylvania. He received a B.S. degree in forest management from Iowa State University, and M.S. and Ph.D. degrees from the University of Arizona. He joined the Station research staff in 1975.

JOSEPH C. MAWSON is Associate Professor of Forestry, Department of Forestry and Wildlife, University of Massachusetts, Amherst. He received a B.S. degree in forestry from the University of Maine in 1956, an M.F. degree from Duke University in 1958, and an M.A. degree in statistics from the University of California, Berkeley, in 1966. He has authored or coauthored 25 articles in forestry, fisheries, and wildlife biology.

BRIAN R. PAYNE is Research Forester for the USDA Forest Service currently on assignment with UNESCO in Paris, France. During the course of this work, he was Project Leader for the Urban Forestry unit at Amherst, Massachusetts. Later he served as Program Manager for the Urban Forest Research Consortium at the Northeastern Forest Experiment Station. He received a B.S. in forestry from the University of California, an M.F. degree from Duke University, and a Ph.D. degree from the University of California.

MANUSCRIPT RECEIVED FOR PUBLICATION 24 APRIL 1980

Abstract

A FORTRAN IV computer program maps the shadows cast by urban tree crowns at selected intervals during the day. The program is convenient to use, requiring only site and tree data. Latitude, date, and time of day are compensated for internally. Each tree on or adjacent to the site is described by height and crown dimensions. A maximum of nine trees is allowed, but a sequential series of computations will produce overlays mapping the shadows cast by additional trees. A test of the program shows that it produces maps within acceptable limits if the tree measurements are accurate.

CROWN SHADOWS FROM THE URBAN FOREST

URBAN FORESTS and the shade cast by trees have been recognized as desirable hetic features of metropolitan areas (Anesen 1978). Crown shadows also affect ysical properties of the urban environment. r example, tree shadows modify the local ergy balance. Consequently, environmental tremes can be reduced by shadows that ay moderate tree water stress. Water stress now recognized as the major factor limiting ɔan tree growth (Potts and Herrington 79). Also, tree shadows can affect residen-l fuel requirements (Heisler and Herring-ı 1976): shading a building in the summer ı lower fuel needs for air conditioning, but nter shade can increase fuel consumption r heating. Knowledge of shadow distribu-ın could be used in urban planning and may en have legal implications. Reitze and itze (1976) discussed responsibilities asso-ıted with changing solar exposure. Although ɔrkers in these disciplines, and probably ıer fields, have an interest in shadow pat-rns, there is no coordinated system to pre-ɛt shadow coverage at a site.

Shadow distribution and orientation vary th time of day and season of year. Before can assess the impact of shadows, we must termine that distribution of shade on the e during the course of a day and at dif-ɛent times during the year. Shadow compu-ions and mapping can be done manually, t the task would be lengthy. In contrast, mputer systems can make laborious compu-ions swiftly and produce maps at compara-ely low cost. The objective of this study ıs to develop a computer mapping system at would delineate crown shade on a site specified times and dates.

Previous work in shadow mapping has en largely confined to rural forests. Shadow urce management has been proposed for vicultural purposes (Marquis 1965) and to ntrol snowmelt (Halverson and Smith ɔ74, 1979). Shadow mapping techniques have been developed to accomplish these forest management objectives (Brown and Merritt 1970, Halverson and Smith 1974, Satterlund 1977). Although these techniques vary in complexity and completeness, none is appropriate for urban forests because they concentrate on shadow length cast into an opening by boundary trees rather than shadow shape. The urban forest, which we define as the forest vegetation complex in and adjacent to populated areas, differs from the rural forest in both use and structure.

Uses of the urban forest are largely for amenity values and benefits and not for wood products. The structure of the urban forest is usually more open, with fewer stems per unit area. Species distribution may not reflect the composition of the native forest in the area. Soil and other site conditions may be altered by surrounding urban development. These kinds of differences between urban and rural forests led us to make some assumptions about urban forests and to define some requirements of a shadow mapping program.

Our assumptions and requirements were:

1. Because the density of urban forests tends to be low, the shadow cast by each crown must be described.
2. Because urban trees are open grown, tree crowns tend to be more spherical or elliptical than crowns developing in a dense forest (Mawson et al. 1976).
3. Urban sites of interest tend to be smaller so shadow mapping can be more detailed than in rural areas.
4. Many urban sites have altered topography, with a tendency to be leveled.
5. Because of the relatively small area mapped, the program must accommodate trees not on the site that may cast a shadow into the mapped area.
6. Because shadows vary drastically with time and date, the program should produce a series of maps based on specification of these variables.
7. The program will be designed for temperate northern latitudes, spanning the distribution of the Nation's urban regions.

Map format

To meet the assumptions and requirements for shadow mapping, we followed certain conventions. We used the normal coordinate system with the origin (0,0) as an arbitrary point on the ground surface selected by the operator. The area covered by the map would be in the quadrant where both X and Y are positive. The length of the map in the X direction (east) would be 10 inches and the Y dimension (north) would be 8.33 inches. These dimensions occupy 100 spaces (X) and 50 lines (Y) on a computer line printer. Actual ground coverage will vary depending on the map scale chosen by the operator.

These conventional techniques mean we can locate a tree base on or off the map in the usual coordinate system. The X coordinate may exceed 100 spaces for a tree east of the mapped area, a negative X would place the tree west of the site. If the Y coordinate is negative, the tree is located southeast or southwest of the map area. By manipulating the coordinates of the tree base, we can map the tree shadow during the hours when the shadow falls in our area of interest.

HARDWARE AND SOFTWARE

The shadow mapping program[1] was developed on an IBM 370 computer[2] in FORTRAN IV language. Recognizing that there are differences and some incompatibilities among computer systems, we tried to use program language that would be acceptable on any system. However, use of our program on another system may require modification of some statements.

We accepted some program inefficiency to make modification less troublesome. The program statements have not been packed, i.e., there are no multiple statements per card image, multiple equalities have not been used, and some computations are repeated so a minor program change will not affect a subsequent calculation. The output device is a standard line printer. We chose the printer because it is the most common output device and no special subroutines are required. Plotters or other display devices may require software or routines unique to a given computer installation and would lessen the utility of the mapping program.

TIME CONVERSION

The expression of time during the day is a variable for which there are several options. In this program, we chose to use true solar time because it gives the most accurate calculation of solar location in the sky.

True solar time is based on true solar noon, the time when the center of the sun crosses the longitude of the observer. Local times are based on 15° time zones, with noon in local standard time occurring approximately when the sun crosses the time zone meridian. Standard time zone meridians for the 48 contiguous States are:

Eastern	75° W
Central	90° W
Mountain	105° W
Pacific	120° W

Daylight time and a realignment of time zone boundaries tend to make clock times unsuitable for solar calculations, so tree solar time is the best for solar calculating and was adapted for program development. However, true solar time can be converted manually to local standard (LST) by a two-step process.

When converting LST to true solar time, the first step is to compute a value known as mean solar time. This step requires knowledge of the longitude of the site. The mean solar time for a site is earlier or later than local standard time by 4 minutes (0.0667 hour) for each degree of longitude the site is displaced from the time zone meridian. Mean solar time is earlier if the site is east and later if the site is west of the time zone meridian. Thus, for a site at 78° W longitude, mean solar noon occurs at 12:12 LST, or when expressed in decimal time, 12.2 hours.

---

[1] The computer program described in this publication is available on request with the understanding that the U.S. Department of Agriculture cannot assure its accuracy, completeness, reliability, or suitability for any other purpose than that reported. The recipient may not assert any proprietary rights thereto nor represent it to anyone as other than a Government-produced computer program. For cost information write: Northeastern Forest Experiment Station, 370 Reed Road, Broomall, PA 19008.

[2] The use of trade, firm, or corporation names in this publication is for the information and convenience of the reader. Such use does not constitute an official endorsement or approval by the U.S. Department of Agriculture or the Forest Service of any product or service to the exclusion of others that may be suitable.

Mean solar time is not equivalent to true solar time because of variations in the orbital path of the earth. The range of variation is approximately -14 to +16 minutes during the year and can be determined from an expression known as the equation of time. Solutions for equation of time have the form (List 1958):

Date Calendar	Julian[a]	Minutes	Hours
Jan. 10	10	- 7.2	-0.12
24	24	- 12.0	- .20
Feb. 7	38	- 14.2	- .24
20	51	- 13.9	- .23
Mar. 7	66	- 11.3	- .19
21	80	- 7.5	- .13
Apr. 4	94	- 3.3	- .05
19	109	+ 0.5	+ .01
May 3	123	+ 3.1	+ .05
18	138	+ 3.7	+ .06
June 1	152	+ 2.4	+ .04
22	173	- 1.6	- .03
July 12	193	- 5.4	- .09
27	208	- 6.4	- .11
Aug. 10	222	- 5.4	- .09
25	237	- 2.3	- .04
Sept. 9	252	+ 2.4	+ .04
23	266	+ 7.3	+ .12
Oct. 8	281	+12.1	+ .20
22	295	+15.3	+ .26
Nov. 5	309	+16.4	+ .27
19	323	+14.7	+ .25
Dec. 3	337	+10.5	+ .18
22	356	+ 1.8	+ .03

[a] In a leap year, add 1 to each value after Feb. 28.

Mean solar time is converted to true solar time by adding the solution for the equation of time for the date. For our example at 78° W and a date of August 3, the value from the equation of time is about -6 minutes (-.10 hour); thus, true solar time is 12:06 (12.10 hours).

Converting true solar time to local standard time is accomplished by a reverse of the technique. First, the table value is algebraically subtracted if the site is west. In our example, true solar time at noon LST was 12:06 (12.10 hours). Subtracting the -6 minutes (-0.10 hour) yields 12:06-(-6) or 12:12 (12.2 hours). Since the site of interest is 3° west of the time zone meridian, we now subtract 12 minutes to yield 12:00. Thus, when true solar time is 12:06 (or 12.10 hours), it is noon in LST.

One additional compensation may be necessary. If daylight time is in effect, clock times must be adjusted. Since the imposition of daylight time is not universal, this correction must also be made manually.

PROGRAM DESCRIPTION

The program is divided into one main program (CROWN) and three subroutines (SPHELP, LOCATE, and PMAP) (Appendix). Each routine does some computations and stores some variables in blank common. Variables stored in common are available to any of the routines and this technique is used to pass computed values from one routine to another. Several unused variables are also dimensioned in common to facilitate program modification or expansion.

Data input

Two types of data are required. Data type I describes the site, the date of interest, and the map parameters. The second data type describes the trees on or near the site. CROWN reads the variables and stores them in arrays.

Program CROWN data cards supply information for computations. The first data card describes the site:

Card Column	4,5	9,10	12,13
Variable	ID	MO	YR
Card Column	17,18,19,20		22-25
Variable	ALAT		ST
Card Column	27,28,29,30		32-35
Variable	ET		TI
Card Column	40	42,43	48
Variable	NT	SC	F

Where: ID = Day number of the month, 01 to 31
MO = Month of the year, 01 to 12
YR = Last two digits of the year; for example, 79
ALAT = Latitude of the site, degrees north. Columns 19 and 20 can be used for decimal parts of a degree.

ST = The starting time of the mapping sequence, true solar. For example 6 a.m. would be entered at 0600 in columns 22 through 25. This value defaults to 0300 if unspecified. If the time specified or the default value is before sunrise, ST is increased to sunrise. Columns 24 and 25 are used for decimal parts of an hour.

ET = Ending time of the mapping sequence, true solar. For example, 5:30 p.m. would be entered as 1750. This value defaults to 2100 if unspecified. If the time specified is after sunset, ET is decreased to sunset.

TI = Time interval between maps on the day specified, hours. If the value is less than .05 hours (3 minutes), this value defaults to 1 hour. Columns 34 and 35 are used for decimal parts of an hour.

NT = Number of trees on the site, maximum of 9, entered in column 40.

SC = Map scale, the number of feet, or meters, per inch on the final printed map, entered in column 42 and 43. Column 41 is used if a map scale greater than 99 is needed. The maximum value for SC is therefore 999 feet (or meters) per inch.

F = Scale factor entered in column 48.

1 = feet
2 = meters

The format of this card is 2I5, 5F5.2, I5, 2F5.2

The second type of data card describes a tree. As many as 9 cards may be entered, but the number of cards must be equal to the value NT on the first data card.

Card Column	8	18	28	38	48	58	68	78
Variable	N	TH	CH	1	V	H	XT	YT

In which:

N = Sequential tree number, 1 through 9, punched in column 8.

TH = Total tree height in feet or meters. The value is entered so that column 18 has the unit value; for example, a tree 30.25 feet tall would be described as 3025 in columns 17 through 20.

CH = Height to the base of the live crown in selected units. The value must be entered so that column 28 has the unit value; for example, a tree with a clear bole for 35 feet would be described as 3500 in columns 27 through 30.

1 = The numeral 1 in column 38. This field is reserved to define other crown shapes; the value 1 refers to a spherical or elliptical crown.

V = The vertical radius of the crown in feet or meters entered so the unit's value is in column 48; for example, a radius of 15.5 feet would be entered as 1550 in columns 47 through 50.

H = The horizontal radius of the crown in feet or meters. The unit values are in column 58; for example, a radius of 10 would be entered in columns 47 through 50 as 1000.

XT = The X coordinate of the tree base in feet or meters. The unit value is entered in column 68; for example, an X coordinate of 50 would be entered as 5000 in columns 67 through 70.

YT = The Y coordinate of the tree base in feet or meters. The unit value is entered in column 78; for example, a

Y coordinate of 25 would be entered as 2500 in columns 77 through 80.

The format of this card is 8F10.2.

Default data are provided for the time values. This was done to preclude attempting to map shadows before sunrise or after sunset and to prevent a series of maps produced without incrementing time through the day. Other data input errors will cause the program to abort or give incorrect results. Date, latitude, and map scales must be specified on the first data card. The number of trees specified must equal the number of tree description cards which follow.

The tree data requirements are stricter. The sequence numbers must be a single digit (1 through 9) and the cards should be in order. An error in tree dimensions or location will give an incorrect map. Total tree height (TH) minus the height to the base of the live crown (CH) should equal twice the vertical radius (2V). There is no default for errors in height or vertical radius because only field inspection can determine which value is in error. Vertical and horizontal radius should be equal if the crown is spherical. If the crown profile is elliptical, the horizontal radius will usually be less than the vertical radius, but this is not a program requirement.

The number of trees was limited to nine for two reasons. First, only a single character can be printed in a location. There are, of course, many other characters we could use. However, the second reason for the limit was that the shadow pattern from a large number of trees becomes too complex to interpret. If the shadows from many trees must be plotted, additional maps can be produced and overlaid to obtain the total pattern.

Program CROWN, the main program

CROWN coordinates data input, checks for unrealistic values and assigns default values in some cases, computes solar location, and coordinates the flow of information to the subroutines. Additionally, it controls the format of the final array in which the map is stored.

Computations accomplished in CROWN are based on the equations needed to locate the sun in the sky. Four equations are used for solar computations:

$$SD = 23.45 \, \mathrm{Cos} \, (DJ + C) \, 360/365.25 \tag{1}$$

$$ST = 12 - T \tag{2}$$

$$A = \mathrm{Sin}^{-1} \, [\mathrm{Sin}(L) \, \mathrm{Sin} \, (SD) + \mathrm{Cos}(L) \, \mathrm{Cos} \, (SD) \, \mathrm{Cos} \, (ST)] \tag{3}$$

$$AZ = \mathrm{Sin}^{-1} \, [\mathrm{Cos}(SD) \, \mathrm{Sin}(ST)/\mathrm{Cos}(A)] \tag{4}$$

The variables are

SD = Solar declination, ranging from -23.45° to 23.45° depending on date and computed internally.
T = True solar time, 0 to 24 hours decimal scale.
ST = True solar time, before or after true solar noon.
A = Solar elevation, radians above horizon.
AZ = Solar azimuth, radians from south.
DJ = Julian date, sequential number of the day during the year.
C = Constant internally assigned to 10.5 or 7.5 depending on the value of DJ.

CROWN uses these equations for the data checking task. The operator selected starting time is checked with equation (3); if the operator's specified starting time is before sunrise, the value ST is adjusted forward to the time of sunrise. Similarly, if ending time is after sunset, the value of ET is incremented back to the time of sunset. Equation (4) is used to determine the due east and west crossing times of the sun and to determine in which of the four quadrants of the sky the sun is located at mapping time. These steps are necessary because azimuths used by the computer are altered to meet machine requirements for angular expressions. Consequently, we must define the solar location by quadrants to correctly map shadows.

CROWN, as a computational task, creates an array of blanks in memory that is used to store the final shadow map. Although any character could be used to create the array, the final output is more understandable with the background blanked. CROWN then calls the computational and mapping subroutines as they are needed.

Subroutine SPHELP, defining the shadow perimeter

In SPHELP (from SPHere and ELliPse), the coordinates of the perimeter of the shadow, in map units of feet or meters, are computed. In an X-Y coordinate system where the X-axis is east and the Y-axis north, the equations are:

$$X = \frac{-CTC(\mathrm{Sin}(AZ\ \ )\mathrm{Cos}(A))}{\mathrm{Sin}(A)} + \frac{V(\mathrm{Cos}(W+AZ\ \ )\mathrm{Cos}(AZ))}{\mathrm{Sin}(A)} + H(\mathrm{Sin}(W+AZ\ \ )\ \mathrm{Sin}\ (AZ\ \ ) + XT \qquad (5)$$

$$Y = \frac{CTC(\mathrm{Cos}(AZ)\mathrm{Cos}(A))}{\mathrm{Sin}\ (A)} + \frac{V(\mathrm{Cos}(W+AZ)\ \mathrm{Sin}\ (AZ\ \ ))}{\mathrm{Sin}(A)} + H(\mathrm{Sin}(W+AZ\ \ )\ \mathrm{Cos}\ (AZ\ \ )) + YT \qquad (6)$$

The undefined terms have the values:

CTC = Height above the ground to the center of the tree crown, map units of feet or meters.

W = An internal variable set at 10°. Thus, the program calculates 36 points from 0 to 360° to define the perimeter of a crown shadow.

The computed coordinates for the crown are stored in an array to remain accessible to other subroutines. This subroutine is called for each crown.

Subroutine LOCATE, screening the data

Within the limitations of the printer, subroutine LOCATE sequentially scales and examines each X and Y printer coordinate of the shadow perimeter. If the X coordinate is in the range $0 < X < 101$ and the Y coordinate is in the range $0 < Y < 51$, the point can be mapped and the sequential tree number is stored in the output map array in the location specified by the XY values. Points with an X or Y coordinate outside the map area are ignored.

The location of the tree base is examined in the same way. If the tree is located on the map, the base is also mapped, and the sequential tree number is stored in the proper location.

The character used to define the shadow perimeter and the tree base is the tree number. Because we use the number technique, each shadow on the map is identified with the source tree. However, because we examine shadows sequentially, points with identical coordinates will be identified by the larger number.

Subroutine PMAP, control of printing

Subroutine PMAP (from Print MAP) serves only to control the printing after all the trees on the site have been examined for a particular time of day. It prints a two-line statement above the map that always begins with the phrase "block 1" and then identifies the scale, date, latitude, and true solar time of the map.

After printing the title, PMAP then prints the map and the X and Y axis. Along the axis, each inch is indexed by the letter "I". The distance value associated with each inch is identified in the lead statement and is not reproduced along the axis.

Options under user control

Two options within the program provide a greater degree of user control. Additional sites, or maps of a given site on a different date, may be mapped by inserting additional sets of site and tree data cards in the data file. The mapping sequence will continue until all data have been processed. This option was included to reduce cost by eliminating the machine time needed to resubmit the program for each site or date.

The second option can be used to map a composite of the daily shadow pattern. The output array is blanked twice in the program. The first such clearing occurs after the input data are stored in an array (see statement 110 in CROWN). The second clearing occurs when all the shadows for a specific true solar time have been plotted on an output map (see statement 899 in CROWN). The time is then incremented forward by the specified time interval and data for a new map are generated. If the second clearing sequence is removed, each map will show the current and all previous shadow locations for the day. The last map will show an envelope, or composite, of the shadow pattern for the entire day. This option was included for those who need to see the progression of the shadow during the day.

OUTPUT AND VERIFICATION

The model was tested by comparing a tree shadow on a level site with program output based on data taken from the same tree.

The test tree was an open-grown red maple (*Acer rubrum* L.). The tree was 34 feet tall with an elliptical crown that had a vertical radius of 14 feet and a horizontal radius of 9.4 feet. It was 6 feet from the ground to the base of the crown. Tree dbh was 8.5 inches. The tree was located at 40° N Latitude and 78° W Longitude. These site and tree data, the date August 3, 1979, and specified true solar times of 8.8 and 10.8 hours were mapped with the program.

On August 3, 1979, we measured the shadow cast by the tree at the specified true solar times. The shadow perimeter was identified by 17 points spaced along the boundary. Each point was then assigned X and Y coordinates corrected to the tree base location. The tree base was assigned coordinates 50, 25 to ensure that the entire shadow appeared on the map.

The computer maps for 8.8 true solar time (Fig. 1) and 10.8 solar time (Fig. 2) show good agreement between the computed and measured shadow. There were minor deviations because of printer limitations and irregularities in crown shape. The printer cannot fraction space either vertically or horizontally, so the coordinates are plotted at the

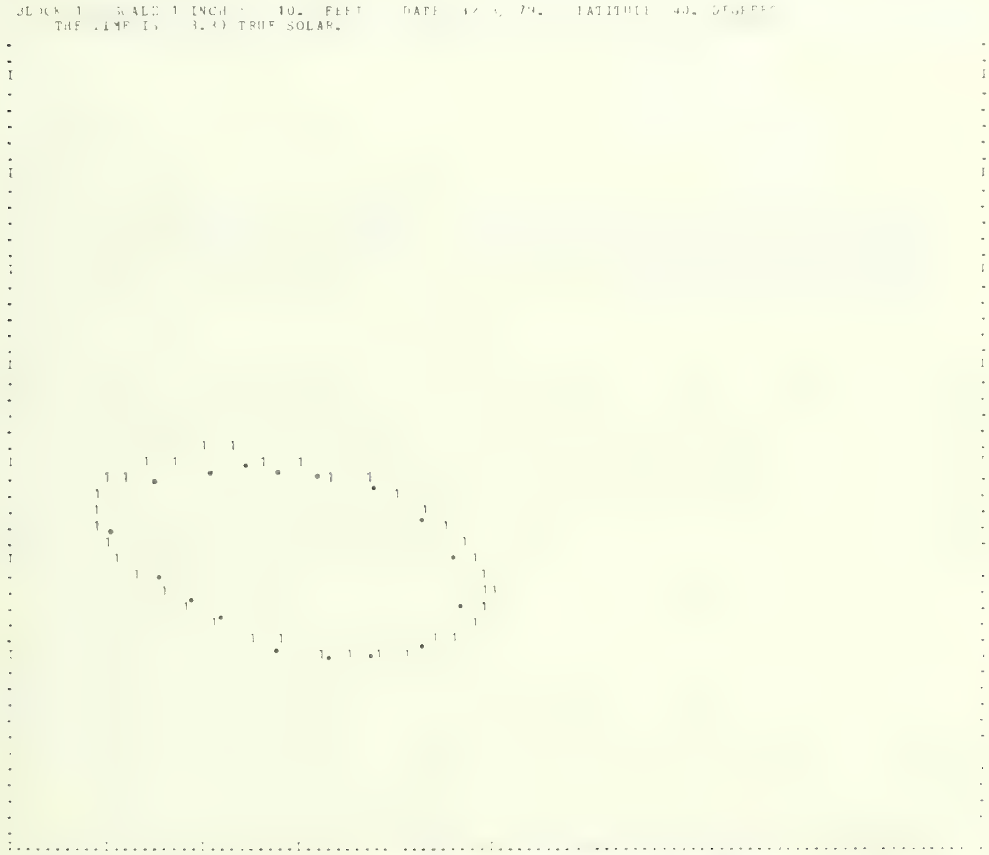
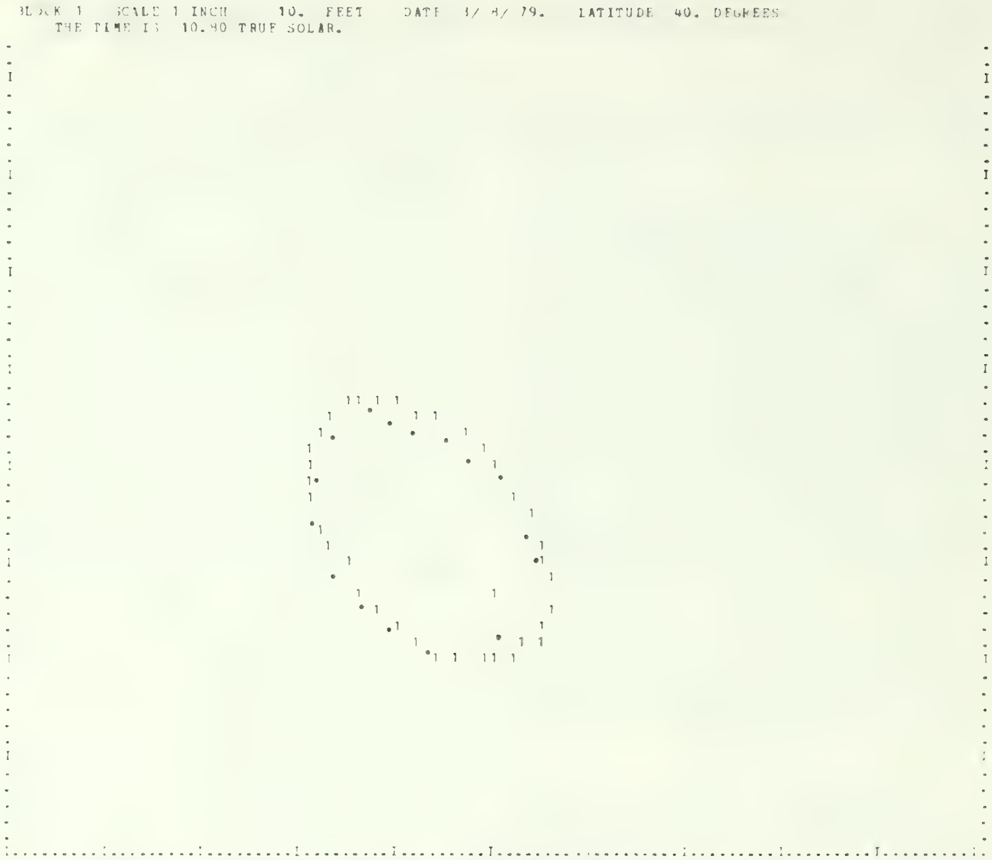


Figure 1.—Computed and measured tree shadow and base for the test tree at 8.8 hours true solar time. The computer representation is the numeral 1; dots identify the measured shadow. The tree base is on the shadow perimeter. (The figure has been reduced by 50 percent.)



```
BLOCK 1   SCALE 1 INCH      10.  FEET     DATE  3/ 8/ 79.    LATITUDE  40. DEGREES
    THE TIME IS  10.80 TRUE SOLAR.
```

Figure 2.—Computed and measured tree shadow and base for the test tree at 10.8 hours true solar time. The computer map uses the numeral 1; dots identify the measured shadow. The tree base is inside the shadow perimeter. (The figure has been reduced by 50 percent).

nearest location. Irregularities in the crown profile also cause small deviations. However, if the tree is measured carefully, and if the crown profile is nearly spherical or elliptical, the program plots an accurate representation of the shadow.

SUMMARY

Shadow patterns affect local energy balances in urban and rural forest sites. This shadow mapping program was developed to meet application needs which have become apparent in urban forestry. Tree water stress, residential fuel requirements, and urban planning objectives can be affected by shadow patterns. Although not of primary interest in this work, shadow distribution may affect human thermal comfort and the urban energy balance. On rural forest sites, shadow patterns can influence the results of silvicultural treatments and snowmelt. Therefore, the shadow mapping program should be useful to foresters managing either urban or rural forests.

Although this shadow mapping program will be useful in many aspects of forestry, the routines used may have some limitations for specific applications. For example, tree crowns of interest may not be spherical or elliptical. The program was written to accommodate expansion to remove the shape limitation. A subroutine for another shape could be added to the program and the variable in column 38 of the tree description card changed and used to call the new subroutine. For other modifications, the variables XX, YY, ZZ, RSE, RSM, NPTS, and NPLPT are dimensioned in common but are available for use in program modification. We deliberately dimensioned these extra variables for future program changes to meet the needs of other users. In each application, the user is most able to decide program requirements, use the mapping program in modified or unmodified form, and implement the results.

REFERENCES

Andresen, John W.
1978. The greening of urban America. Am. For. 84(11):10-12, 56-61.

Brown, Kenneth M., and Clair Merritt.
1970. A shadow pattern simulation model for forest openings. Purdue Univ. Agric. Exp. Stn. Res. Bull. 868, 11 p.

Halverson, Howard G., and James L. Smith.
1974. Controlling solar light and heat in a forest by managing shadow sources. USDA For. Serv. Res. Pap. PSW-102, 14 p.

Halverson, Howard G., and James L. Smith.
1979. Solar radiation as a forest management tool: A primer of principles and application. USDA For. Serv. Gen. Tech. Rep. PSW-33, 13 p.

Heisler, Gordon M., and Lee P. Herrington.
1976. Selection of trees for modifying metropolitan climates. *In* Better trees for metropolitan landscapes. Frank S. Santamour, Jr., Henry D. Gerhold, and Silas Little, eds. USDA For. Serv. Gen. Tech. Rep. NE-22, p. 31-37.

List, Robert J.
1958. Smithsonian meterological tables. 6th ed. Smithsonian Inst., Washington, D.C. 527 p.

Marquis, David A.
1965. Controlling light in small clearcutting. USDA For. Serv. Res. Pap. NE-39, 16 p.

Mawson, Joseph C., Jack Ward Thomas, and Richard M. De Graaf.
1976. Program HTVOL: The determination of tree crown volume by layers. USDA For. Serv. Res. Pap. NE-354, 9 p.

Potts, Donald F., and Lee P. Herrington.
1979. Modeling and measurement of evapotranspiration. 14th Conf. Agric. For. Meteorol. and 4th Conf. on Biometerol. [April 2-6, Minneapolis, Minn.] p. 188-189.

Reitze, Arnold W., Jr., and Glen L. Reitze.
1976. Protecting a place in the sun (Part one). Environment 18(5):2-4.

Satterlund, Donald R.
1977. Shadow patterns located with a programmable calculator. J. For. 75(5):262-263.

APPENDIX

```
       IMPLICIT REAL*8(A-H,O-Z)
       DIMENSION MT(12)
       COMMON/C8/ P(9,36),Q(9,36),TD(9,8),XX(36),
      1YY(36),ZZ(36),AL,ALAT,AR1,AZ,CO,D,DJ,ET,F,H,R,
      2RP,RSR,RSM,SA,SCALE,SIG,SLD,SOD,SOTC,SP,SS,ST,TI,
      3YR,XS,YS,XT,YT,CDR,PI
       COMMON/C4/ IPCK(9),MC(3,3),MN(9),I,ID,IQ,IR1,ITN,IZ,
      1KJ,K,J,M3,MO,MS,ND,NPTS,NT,NPLPT
       LOGICAL*1 IP(1,100,50)
       COMMON/C1/IP
C===========================================================
C     THIS IS THE CONTROL ROUTINE FOR PROGRAM CROWN.
C     IT ALSO PERFORMS SOME COMMON CALCULATIONS.  THE
C     LABELED COMMON C8 RESERVES SPACE FOR DOUBLE
C     PRECISION VARIABLES.  COMMON C4 RESERVES SPACE
C     FOR INTEGER VARIABLES.  COMMON C1 AND THE
C     LOGICAL STATEMENT RESERVE A SINGLE SPACE FOR
C     EACH CHARACTER IN THE FINAL OUTPUT ARRAY FOR
C     THE MAP.  SOME REAL AND INTEGER VARIABLES ARE
C     RESERVED FOR FUTURE USE.
C===========================================================
C
C
C===========================================================
C     THE FOLLOWING ARITHMETIC STATEMENT FUNCTIONS
C     CAUSE TRIGNOMETRIC COMPUTATIONS TO USE DOUBLE
C     PRECISION ARITHMETIC.
C===========================================================
       SIN(X)=DSIN(X)
       COS(X)=DCOS(X)
       TAN(X)=DTAN(X)
       ASIN(X)=DARSIN(X)
       ACOS(X)=DARCOS(X)
       DATA MT/0,31,59,90,120,151,181,212,243,273,304,334/
    1) READ(5,1000,END=999)ID,MO,YR,ALAT,ST,ET,TI,NT,SCALE,F
C===========================================================
C     THE REQUIRED INPUT INFORMATION DESCRIBES THE
C     SITE.  VARIABLES ARE:
C           ID        DAY OF THE MONTH
C           MO        MONTH OF THE YEAR, NUMBER
C           YR        LAST TWO DIGITS OF THE YEAR
C         ALAT        LATITUDE OF THE SITE, DEGREES
C           ST        STARTING TIME OF THE MAP SEQUENCE,
C                         DECIMAL HOURS
C           ET        ENDING TIME OF THE MAP SEQUENCE,
C                         DECIMAL HOURS
C           TI        TIME INTERVAL BETWEEN MAPS ON THE
C                        SELECTED DAY, DECIMAL HOURS
C           NT        NUMBER OF TREES, MAXIMUM OF 9
C        SCALE        NUMBER OF FEET OR METERS PER INCH
```

```
C                     ON THE COMPUTER MAP
C          F      SELECT SCALE UNITS;
C                     1 = FEET
C                     2 = METERS
C=================================================
      PI=DATAN(1.D0)*4.
C=================================================
C    COMPUTE A FACTOR WHICH WILL BE USED TO CONVERT

C    DEGREES TO RADIANS (CDR)
C=================================================
      CDR=PI/180.
      ALAT=ALAT*CDR
      DO 20 IL=1,NT
   20 READ 1001,(TD(IL,K),K=1,8)
C=================================================
C    THE REQUIRED INPUT INFORMATION DESCRIBES THE
C    TREES ON THE SITE.  THE SUBSCRIPT IL REACHES A
C    MAXIMUM OF NT SET ON THE SITE DESCRIPTION CARD.
C    THE EIGHT TREE VARIABLES SUBSCRIPTED BY K ARE:
C          1      SEQUENTIAL TREE NUMBER, 1 THROUGH 9
C          2      TREE HEIGHT IN THE UNITS SELECTED
C          3      HEIGHT FROM THE GROUND TO THE BASE
C                     OF THE CROWN
C          4      THE SIDE SHAPE OF THE CROWN WHERE:
C             1 = SPHERE OR ELLIPSE
C          5      VERTICAL RADIUS OF THE CROWN IN
C                     SELECTED UNITS
C          6      HORIZONTAL RADIUS OF THE CROWN IN
C                     SELECTED UNITS
C          7      X COORDINATE OF THE TREE BASE IN
C                     THE SELECTED UNITS
C          8      Y COORDINATE OF THE TREE BASE IN
C                     THE SELECTED UNITS
C=================================================
      XS=SCALE/10.
      YS=SCALE/6.
      KJ=0
      I=0
      J=0
   30 CONTINUE
      II=1
      IF(TI.LT.0.05) TI=1.
      IF(ST.LE.1.) ST=3.
      IF(ET.LE.1.) ET=21.
      DO 110 JJ=1,100
      DO 110 KK=1,50
  110 CALL CHMOVE(' ',IP(II,JJ,KK),1)
      DJ=MT(MO)+ID
      YR1=YR/4.
      IR1=YR1
      AR1=IR1
      D=YR1-AR1
      IF(D.EQ.0) GO TO 120
      GO TO 125
  120 IF(MO.GE.2) DJ=DJ+1
  125 IF(DJ.GE.335) GO TO 126
      IF(DJ.LE.213) GO TO 126
      CO=7.5
      GO TO 127
  126 CO=10.5
  127 CONTINUE
      SRD=(DJ+CO)*CDR
      DMM=(-23.45*CDR)
      SOD=DMM*COS(SRD)*360./365.25
      DO 128 IST=1,900
      G=(12.-ST)*15.*CDR
      A=ASIN(SIN(ALAT)*SIN(SOD)+COS(ALAT)*COS(SOD)*COS(G))
      IF(A.GE.0.) GO TO 129




      ST=ST+.01
  128 CONTINUE
  129 CONTINUE
      DO 130 IET=1,900
      G=(12.-ET)*15.*CDR
      A=ASIN(SIN(ALAT)*SIN(SOD)+COS(ALAT)*COS(SOD)*COS(G))
      IF(A.GE.0.) GO TO 131
      ET=ET-.01
  130 CONTINUE
  131 CONTINUE
      DE=0.
      T=3.
      DO 132 IE=1,900
      E=(12.-T)*15.*CDR
      B=ASIN(SIN(ALAT)*SIN(SOD)+COS(ALAT)*COS(SOD)*COS(E))
      BP=COS(SOD)*SIN(E)/COS(B)
      IF(DE.GE.BP) GO TO 133
      DE=BP
      T=T+.01
  132 CONTINUE
  133 T=T-.01
      TDW=24.-T
      IDE=T
      N=(ET-ST)/TI+1
      ST=ST-TI
  134 CONTINUE
      ST=ST+TI
      H=(12.-ST)*15.*CDR
  135 I=I+1
```

```
C===================================================
C     IF THESE CARDS ARE DELETED THE FINAL MAPS WILL
C     SHOW CURRENT AND ALL PREVIOUS SHADOW LOCATIONS
C     FOR THE DAY.
      II=1
      DO 899 JJ=1,100
      DO 899 KK=1,50
  899 CALL CHMOVE(' ',IP(II,JJ,KK),1)
C===================================================
      IF(I-N)401,401,10
  401 AL=ASIN(SIN(ALAT)*SIN(SOD)+COS(ALAT)*COS(SOD)*COS(H))
      AZ=ASIN(COS(SOD)*SIN(H)/COS(AL))
      IF(ST.LE.TDE) AZ=PI-AZ
      IF(ST.GE.TDW) AZ=0.-PI-AZ
      ITN=0
  500 CONTINUE
      DO 700 J=1,NT
      ITN=ITN+1
  501 XT=TD(J,7)
      YT=TD(J,8)
      R=TD(J,5)
      MS=TD(J,4)
      MB=TD(J,5)
      TH=TD(J,2)
      CONTINUE
 6000 CALL SPHELP
      GO TO 99
   99 CALL LOCATE
  700 CONTINUE
      CALL PMAP
      GO TO 134



 1000 FORMAT(2I5,5F5.2,I5,2F5.2)
 1001 FORMAT(8F10.2)
  999 CONTINUE
      STOP
      END
      SUBROUTINE SPHELP
      IMPLICIT REAL*8(A-H,O-Z)
      COMMON/C8/ P(9,36),Q(9,36),TD(9,8),XX(36),
     1YY(36),ZZ(36),AL, ALAT,AR1,AZ,CO,D,DJ,ET,F,H,R,
     2RP,RSE,RSM,SA,SCALE,SIG,SID,SCD,SCTC,SP,SS,ST,TI,
     3YR,XS,YS,XT,YT,CDR,PI
      COMMON/C4/ IPCK(9),MC(3,3),MN(9),I,ID,IQ,IR1,ITN,IZ,
     1KJ,K,J,MB,MC,MS,ND,NPTS,NT,NPLPT
      LOGICAL*1 IP(1,100,50)
      COS(X)=DCOS(X)
      SIN(X)=DSIN(X)
      ASIN(X)=DARSIN(X)
      SIG=AZ-PI/2.
      THA=AL
      SW=10.*CDR
      W=0.-SW
      CTC=TD(J,2)-R
      A=TD(J,6)
      B=TD(J,5)
      DO 49 K=1,36
      W=W+SW
      P(J,K)=(0.-CTC*SIN(AZ)*COS(THA)/SIN(THA))+((B/SIN(THA))*
     1COS(W+SIG)*COS(SIG))+(A*SIN(W+SIG)*SIN(SIG))+XT
      Q(J,K)=(CTC*COS(AZ)*COS(THA)/SIN(THA))+((B/SIN(THA))*
     1COS(W+SIG)*SIN(SIG))-(A*SIN(W+SIG)*COS(SIG))+YT
   49 CONTINUE
      RETURN
      END
      SUBROUTINE LOCATE
      IMPLICIT REAL*8(A-H,O-Z)
      DIMENSION IBX(9),IBY(9)
      COMMON/C8/ P(9,36),Q(9,36),TD(9,8),XX(36),
     1YY(36),ZZ(36),AL, ALAT,AR1,AZ,CC,D,DJ,ET,F,H,R,
     2RP,RSE,RSM,SA,SCALE,SIG,SID,SCD,SCTC,SP,SS,ST,TI,
     3YR,XS,YS,XT,YT,CDR,PI
      COMMON/C4/ IPCK(9),MC(3,3),MN(9),I,ID,IQ,IP1,ITN,IL,
     1KJ,K,J,MB,MC,MS,ND,NPTS,NT,NPLPT
      COMMON/C1/IP
      LOGICAL*1 IP(1,100,50),IDIGIT(9)
      DATA IBX/0,100,200,0,100,200,0,100,200/
      DATA IBY/0,0,0,100,100,100,200,200,200/
      DO 200 K=1,36
      XP=P(J,K)/XS+.5
      YQ= Q(J,K)/YS+.5
      IX=XP
      IY=YQ
      IB=1
      IF(IX.LE.0) GO TO 200
      IF(IX.GE.101) GO TO 200
   14 CONTINUE
      IF(IY.LE.0) GO TO 200
      IF(IY.GE.51) GO TO 200
   24 CONTINUE
   25 CONTINUE
      JX=IX-(IBX(IB))
      IF(JX.LT.1) JX=1
      JY=51-(IY-IBY(IB))
      IF(JY.LT.1) JY=1
      DATA IDIGIT/'1','2','3','4','5','6','7','8','9'/
      IP(IB,JX,JY)=IDIGIT(ITN)
  200 CONTINUE
      KX=XT/XS-(IBX(IB))
      IF(KX.LT.1) GO TO 201
      IF(KX.GE.100) GO TO 201
      KY=51-(YT/YS-IBY(IB))
      IF(KY.LT.1) GO TO 201
      IF(KY.GT.50) GO TO 201
      IP(IB,KX,KY)=IDIGIT(ITN)
  201 CONTINUE
      RETURN
      END
      SUBROUTINE PMAP
      IMPLICIT REAL*8(A-H,O-Z)
      COMMON/C8/ P(9,36),Q(9,36),TD(9,8),XX(36),
     1YY(36),ZZ(36),AL, ALAT,AR1,AZ,CO,D,DJ,ET,F,H,R,
     2RP,RSE,RSM,SA,SCALE,SIG,SID,SOD,SOTC,SP,SS,ST,TI,
     3YR,XS,YS,XT,YT,CDR,PI
      COMMON/C4/ IPCK(9),MC(3,3),MN(9),I,ID,IQ,IR1,ITN,IZ,
     1KJ,K,J,MB,MO,MS,ND,NPTS,NT,NPLPT
      LOGICAL*1 IP(1,100,50),UNITS(6)
      COMMON/C1/IP
      DO 5 II=1,9
    5 MN(II)=0
      NM=0
      II=1
   35 NM=NM+1
      MN(NM)=I
   40 CONTINUE
      DO 45 II=1,NM
      K=MN(II)
      K=1
      CALL CHMOVE('FEET  ' ,UNITS,6)
      IF(F.GE.1.5) CALL CHMOVE('METERS',UNITS,6)
      XLAT=ALAT/CDR
      PRINT 300,K,SCALE,UNITS,ID
     1,MO,YR,XLAT,ST
   42 CONTINUE
      DO 45 M=1,50
      IF(M.EQ.3) GO TO 43
      IF(M.EQ.9) GO TO 43
      IF(M.EQ.15) GO TO 43
      IF(M.EQ.21) GO TO 43
      IF(M.EQ.27) GO TO 43
      IF(M.EQ.33) GO TO 43
      IF(M.EQ.39) GO TO 43
      IF(M.EQ.45) GO TO 43
      PRINT 302,(IP(K,N,M),N=1,100)
      GO TO 45
   43 PRINT 303,(IP(K,N,M),N=1,100)
   45 CONTINUE
      PRINT 301
  300 FORMAT('1',9X,'BLOCK ',I1,2X,' SCALE 1 INCH = ',2X
     1 ,F3.0,2X,6A1,'  DATE ',I2,'/',I2,'/',F4.0,
     23X,'LATITUDE  ',F3.0,' DEGREES',/,12X,
     32X,'THE TIME IS  ',
     4 F5.2,' TRUE SOLAR.')
  301 FORMAT(9X,'I',10('.........I'),'.')
  302 FORMAT(9X,'.',100A1,'.')
  303 FORMAT(9X,'I',100A1,'I')
      RETURN
      END
```

☆U.S. GOVERNMENT PRINTING OFFICE: 1980-603-111/25

Headquarters of the Northeastern Forest Experiment Station are in Broomall, Pa. Field laboratories and research units are maintained at:

- Amherst, Massachusetts, in cooperation with the University of Massachusetts.
- Beltsville, Maryland.
- Berea, Kentucky, in cooperation with Berea College.
- Burlington, Vermont, in cooperation with the University of Vermont.
- Delaware, Ohio.
- Durham, New Hampshire, in cooperation with the University of New Hampshire.
- Hamden, Connecticut, in cooperation with Yale University.
- Kingston, Pennsylvania.
- Morgantown, West Virginia, in cooperation with West Virginia University, Morgantown.
- Orono, Maine, in cooperation with the University of Maine, Orono.
- Parsons, West Virginia.
- Princeton, West Virginia.
- Syracuse, New York, in cooperation with the State University of New York College of Environmental Sciences and Forestry at Syracuse University, Syracuse.
- University Park, Pennsylvania, in cooperation with the Pennsylvania State University.
- Warren, Pennsylvania.

GOVT. DOCUMENTS
DEPOSITORY ITEM

OCT 27 1980

CLEMSON
LIBRARY

ODC 273(048.1)

Abstracts of Urban Forestry Research in Progress - 1979

CLEMSON UNIVERSITY
OCT 29 1980
SCI. TECH

Urban Forest Research Project
USDA Forest Service
Northeastern Forest Experiment Station

and

The State University of New York
College of Environmental Science and Forestry
Syracuse, New York 13210

in cooperation with

The Pinchot Institute for Conservation Studies
USDA Forest Service
Milford, Pennsylvania 18337

USDA Forest Service GTR-NE-60
September 1980

This report is a product of Cooperative Research Agreement No. 42-269 between the USDA Forest Service, Northeastern Forest Experiment Station and the State University of New York College of Environmental Science and Forestry.

The use of trade, firm or corporation names in this publication is for the information and convenience of the reader. Such use does not constitute an official endorsement or approval by the U.S. Department of Agriculture or the Forest Service of any product or service to the exclusion of others that may be suitable.

ABSTRACTS OF URBAN FORESTRY

RESEARCH IN PROGRESS--1979

Compiled by
Rowan A. Rowntree
Judith L. Wolfe

CONTENTS

The Urban Forest Research Project at Syracuse 1

Index of research in progress, 1979 14

Abstracts 17

The compilers are Project Leader, Urban Forest Research Project, USDA Forest Service, and Research Assistant, State University of New York College of Environmental Science and Forestry, Syracuse, New York 13210, (315) 473-8673, respectively.

USDA FOREST SERVICE GENERAL TECHNICAL REPORT NE-60
September 1980

Northeastern Forest Experiment Station
Forest Service, U.S. Department of Agriculture
Broomall, Pennsylvania 19008

FOREWORD

Urban Forestry, as science and practice, grows daily with new information being developed by both researchers and resource managers. Some of this information is found in publications and scientific journals. Much of it, however, is not yet in a form that can be conveyed through formal channels. By summarizing research in progress, this report keeps researchers informed of ongoing work and helps urban forest managers anticipate results of interest to them.

All individuals and organizations thought to be conducting research in urban forestry were contacted and asked to complete abstracts of their work. The abstracts cover only research in progress at the time of our inquiry in early 1979. Some projects will have been completed by the time this report is received. We regret the time lag between our initial inquiry and the publication of this summary. The section containing studies conducted by the Forest Service research project at Syracuse is current as of the date of this report.

Some omissions have come to our attention as this report goes to press. If this publication proves useful, it is hoped that subsequent summaries of research in progress will be printed and that more complete coverage will be possible. The objective is to open channels between those who do research and those who use the results.

The Abstracts are organized as follows: (1) an unindexed summary of research being done at the USDA Forest Service, Urban Forest Research Project, State University of New York College of Environmental Science and Forestry, Syracuse, and (2) abstracts of other research in progress in early 1979, preceded by an index. These abstracts are categorized by subject, each subject having an assigned number. The index is arranged by subject matter numbers, and indicates the last name(s) of the researcher(s) and the page on which the abstract appears. Within each subject matter the researchers are listed alphabetically.

In this system, if the work deals with more than one topic, a single researcher's name may appear under several subject matter headings in the index. However, each abstract appears only once in the text, and is placed in the category that reflects most closely the primary subject of the research. Reports from research institutions that include abstracts of several different studies have been located in the text according to their subject matter number of lowest value. The subject matter numbers at the top of each page are indicators of ordering sequence only, and do not reflect the full range of topics on that page.

In most cases, the texts for the abstracts were taken directly from the researchers' responses to our inquiries with only minor editorial changes. When necessary, we condensed or took excerpts from some replies. Those cases are indicated in the text. The amount of information in each abstract varies with the completeness of the researcher's response to our inquiry. Bibliographic entries are only as complete as the replies allowed. We attempted to include the full address, sponsor, starting and completion dates of the study. If the project is a graduate thesis, the student's name precedes the advisor's, which appears in parentheses. In cases where the abstract is too abbreviated or references are incomplete, the reader is encouraged to write directly to the principal investigator for additional information.

The Pinchot Institute for Conservation Studies, USDA Forest Service, Milford, Pennsylvania, funded a substantial portion of the work for this report through the Northeastern Forest Experiment Station. The Urban Forest Research Project of the Northeastern Forest Experiment Station is located on the campus of the SUNY College of Environmental Science and Forestry, Syracuse, and is aided by the many faculty and students of that institution. Professor Donald E. Koten is principal investigator for this cooperative study. Professor Lee P. Herrington conceived the idea for an annual summary of research and worked actively on the project to its conclusion. Ms. George Hopkins Stauffer, Research Associate, was valuable in the organization and editing of the Abstracts, and Ms. Linda Rask assisted in the publication. All of those involved hope that the report improves communication of ideas among the growing community of urban forestry participants.

--ROWAN A. ROWNTREE
JUDITH L. WOLFE

THE URBAN FOREST RESEARCH PROJECT

AT SYRACUSE

The U.S. Forest Service Urban Forest Research Project, located at the State University of New York College of Environmental Science and Forestry, focuses on three general problem areas:

1. the ecological structure and function of urban forest vegetation,

2. how different forest vegetation configurations generate benefits and costs for various sectors of society and how the benefits and costs are distributed over time, and

3. what types of planning and management must be accomplished to achieve the optimum mix of benefits and costs for different classes of cities.

The project was initiated in 1978 and conducts basic and applied research with a core scientific staff supplemented by grants to cooperating researchers. General areas of research are:

1. Inventory and ecological classification of urban forest vegetation and associated soil resources. This work has been conducted primarily at Syracuse, but emphasizes the development of methods that can be applied to other cities.

2. Land use change as it affects urban forest vegetation. An emphasis on patterns experienced by northeastern cities, in particular the emergence of an important residual land resource in the central city.

3. Land use and land use change in the central city as it affects microclimate at the scale of the human being. Emphasis on the urban heat island effect, air pollution, and wind/radiation regimes in the central city.

4. Energy, land use, and urban vegetation. An examination of probable impacts of future energy prices on urban land use and urban vegetation resources.

5. Construction of a theory of urban vegetation ecology as related to land use and land control. Testing of systems analysis for application to urban environments.

6. Determining the most appropriate planning and management principles, models and methods for guiding the distribution of benefits and costs relative to the urban forest resource.

The Syracuse project directs two major studies that will resolve how the state of the art in urban forest science can be applied to (1) a central city situation having air pollution and microclimate problems and (2) an exurban situation where maintenance of environmental quality in the face of urbanization is the main issue. The central city study is being conducted in Dayton, Ohio, with the long term objective of transferring this experience to other cities of approximately the same size. The exurban study is taking place on the Brandywine watershed in Chester County, Pennsylvania, outside Philadelphia. Knowledge from the research foci listed above (1-6) is being incorporated into the Dayton and Brandywine demonstration projects.

The following are abstracts of specific studies being conducted by Project personnel in conjunction with scientists at cooperating institutions.

Development of improved urban forest management programs with emphasis on planning practice

Urban tree resources have a dominant role in the values and environmental impacts of urban space. For example, in Syracuse, New York, urban tree resources are typical of most maturing cities, where urban tree resources have been established concurrently with older residential development. Once vigorous and dense tree populations have now been substantially depleted by disease and aging. Remaining tree populations are disproportionately old-aged and unevenly distributed. During the past decade, substantial urban tree replacement programs have been mounted at considerable expense. However, these efforts have been inadequate to renew and reorder the urban tree resource in keeping with public pressures for improved environmental quality. Now that federal and state support for urban forestry is becoming available to cities, there is a special need for urban forestry academic and agency research to be directed to improved management planning and practice to help cities respond effectively to expanding opportunities. The purpose of this study is to strengthen the base of working information on the physical, natural, and social environment of the city tree-space resource. The study considers the optimal size, distribution, and other characteristics of tree populations for management goals, the present functional life expectancy of replaced trees under present management conditions, and ways of improving management procedures.

Specific objectives: (1) Conduct a 100% sample of street-side trees and planting space (including adjacent land use characteristics) and (2) organize the data for introduction into urban forest planning and management decision making.

Classification of urban forest soils

Urbanization of the landscape, especially in the Northeast, has brought about the need for change in soils classification to emphasize limitations and capabilities of soils for various uses. Existing soil interpretations for nonagricultural use are based on natural soil profiles or those found under agriculture and, thus, have real limitations when applied to the disturbed soils of the urban areas. Up to the present time soils have simply been mapped as "urban land" with no further differentiation between central business districts, inner city areas, and exurban perimeters. Urban foresters have need for a more appropriate and useful soil classification and mapping scheme, so that soil interpretations for urban forestry and related open space uses can be validly developed and utilized.

Specific objectives: Develop, through extensive field sampling and physical-chemical analysis, an urban soil classification system based upon the conditions found in Syracuse, New York, with the ultimate goal of developing a system applicable to other cities.

The Urban Heat Island related to distribution of surface material and vegetation (See Flynn, page 17.)

Changes in urban physical morphology and microclimate: 1950-1980 (See Wolfe, page 19.)

Energy costs and the urban forest ecosystem - I

There is an interdependent relationship between urban land use and the urban forest. On the one hand, the pattern of urban land use determines the structure of the urban forest ecosystem. On the other, aspects of the urban forest determine what land uses will occur in certain parts of the city. Thus, the land-use and urban forest systems are "coupled," and, in addition, both systems are dynamic and evolving rather than static.

It is clear that urban forest planning requires knowledge about future states of the urban land-use system. To predict these future states, it is necessary to understand the factors governing land-use change in the city. These can be categorized broadly as social, political (including legal, legislative), and economic. One of the most important factors in the economic sector (but permeating the social and political sectors as well) is the steadily increasing price of conventional fuels.

It appears to be a common assumption that the prices of the important conventional fuels (natural gas, coal, petroleum, uranium) will continue to increase over the next 10 to 20 years. It is suggested, furthermore, that increases in energy cost will figure prominently in future land-use changes. In a symposium on this topic, there was little agreement on whether the American city would continue to suburbanize, recentralize, or articulate a pattern somewhere in between ("Future Land Use: Energy, Environmental, and Legal Constraints", Burchell, R. W., and D. Listoken, eds., Center for Urban Policy Research, Rutgers University, 1975).

Specific questions pertaining to cities in the Northeast are: (1) Will industries that rely heavily on certain fuels leave the region, or significantly reduce production and employment? (2) Will areas of oldest housing in the central city be economically uninhabitable because of (a) low and fixed income tenants, (b) capital costs of retrofitting these residential structures for energy efficiency, (c) deregulation of prices of home heating fuels. And, if so, what effect will demolition of these structures have on the urban environment and on the requirements of urban forest planning? (3) Will the use of cordwood for home heating change the value of near-urban wooded lands, and what secondary effect will this have on suburban residential development? (4) Will leisure time be spent in different ways and change demands for different categories of urban land use, such as open space, indoor recreational, etc.? These four questions are examples of how land-use changes brought about by increasing energy prices will impact urban forest planning and management.

Specific objectives: From a review of existing literature and data, estimate price increases for conventional fuels for residential, commercial, transportation, and industrial consumption sectors; develop a generalized "energy budget" for the Syracuse metropolitan area (energy budget = sector consumption by fuel type); estimate, in terms of land use/ownership/control, impacts of predicted price increases on each consumption sector.

Energy costs and the urban forest ecosystem - II

Within the last decade, energy costs have become a major determinant of urban land-use decisions that are changing both public and private sector behavior toward the ownership, use, and control of land in the metropolitan area. Urban natural resources planning, including urban forestry management, must now consider the manifold aspects of energy costs and interruptions in supply of conventional fuels. Long-term planning of the urban system will need to confront shifts in technology, changes in emissions regulations, lifestyle modifications of urban residents, and a diminishing capacity of the city's public sector to provide services. Demands for maximizing benefits of urban vegetation at least cost must soon be met by understanding the energy implications and by examining specific aspects of urban forestry planning and management that can increase the efficiency of a metropolitan area's energy budget. Consideration will be given to questions of energy production and consumption relative to urban vegetation within the context of the urban land-use system. This study continues work that was begun under Cooperative Agreement 23-083 and will employ Onondaga County, New York as a case system. The methods and models developed in the study will have application to other metropolitan systems in the U.S.

Specific objectives: (1) Develop a model to relate energy use and availability; land ownership, use, and control; relevant lifestyle factors of county residents; and urban vegetation management. The model is to be used for simulating future changes and is to be evaluated as a tool for urban natural resource planning and management. (2) Identify and examine one major problem of land-use change and urban forest management on which to focus investigations of a more precise nature. Candidates are: (a) increasing amounts of vacant land in the central city, (b) changing land economics of near urban woodlands, (c) loading of multi-use demands on urban and near-urban greenspace and woodlands, (d) need for highly efficient urban natural resource and vegetation management plans as part of countywide energy management planning processes, and (e) likely impacts of wood burning on composition, condition and management of near-urban woodlands. (3) Construct a specific research agenda in the area of energy, land use, and urban forest planning/management to be implemented by Work Unit 1904 over the next 5 years. The agenda shall be written following the format of Forest Service problem analyses.

A computer-graphic analytic method for ecological land-use planning and management

Comprehensive planning and management of urban forest resources requires an automated data processing capability that can integrate a number of variables (biophysical, economic, demographic, etc.) for geographic display and analysis. This capability is necessary for (1) inventorying soils, slope, ground water, etc. in conjunction with the spatial distribution of the urban forest and associated vegetation; (2) analyzing spatial relationships among a range of factors associated with the functioning of the urban forest resource; (3) displaying and evaluating alternative urban forest/land-use configurations. A computer-graphic method is needed that can be used for both urban forestry research and for urban forestry planning/management decision making. Recently, a computer-graphic method has been developed at Harvard University that is designed for both research and planning: the IMGRID system.

Specific objectives: (1) Acquire the IMGRID system at SUNY-CESF and train selected researchers to employ it for urban forestry research and applications; (2) test and refine the system using a Syracuse-based data set in preparation for application to the second (planning) phase of the Brandywine studies.

Translation and transfer of information for use in planning and management of municipally-owned urban forest resources

This study is an outgrowth and extension of Cooperative Agreement 23-001. The purpose of 23-001 was to collect and interpret base information on the streetside greenspace resource and the city's street tree replacement program, and to acquire base information for identification of additional management-oriented research appropriate to this subject area.

The next logical phase of investigation is to translate and transfer information for use in the city street tree planning and management process. Management of the public street tree resource involves the interaction of management agency objectives and constraints with public values and inputs. Technical information on the resource and its management options is a significant third factor to the extent that it can be effectively incorporated in the agency/public process.

Specific objectives: (1) Analyze further the streetside space and tree resource data from the preceding study, with particular attention to its interrelationships with other information available, such as operations records of the managing agency (Syracuse Department of Parks and Recreation) Department of Transportation data and plans, utility companies' data and plans, census and other city information, and existing data and plans from Syracuse Department of Community Development. (2) Examine further the present street tree management and replacement process in Syracuse as it reflects agency objectives and constraints and public values and inputs, in order to identify needs for improved resources information and the appropriate levels and formats of such information. (3) Develop planning and operational processes for incorporating appropriate resource information into the process of interaction between city and citizens. (4) Compare the results of this study with available information on street tree management of other cities to identify unique versus more universal elements in this Syracuse case study.

The vacant land component of urban land use change models

There is an interdependent relationship between the urban forest and urban land uses. Existing vegetation influences the location of various land uses and residential groups through the mechanism of environmental preferences and land values. Conversely, the form and distribution of urban land uses determine the structure of the urban forest by providing a matrix within which vegetation can be located and managed. Also, certain species may be more successful when located near certain land uses, or the public may express preferences for particular species near particular land uses.

The development of an urban forestry management plan requires knowledge of the distribution of land uses in American cities. Concepts of spatial and temporal patterns of land use change and their relationship to the urban forest are necessary in order to anticipate future urban forestry management opportunities and problems. There are a number of factors governing urban land-use change: land values and the changing demand for various categories of land use, the changing structure of the city's economy, the condition of existing buildings, property taxes, public intervention in the urban land market, and the increasing cost of energy. Also, social variables, such as the changing distribution of various social, economic, and age groups within the city and their preferences for various residential locations, forms of tenure, and environmental preferences regarding vegetation and aesthetics, add other dimensions to the urban land market and the resulting distribution and intensity of land uses.

Vacant and unbuilt land presents a new and possibly important opportunity for urban forest and vegetation management. Much vacant land and transitional uses, such as parking lots, are located in the core areas of older American cities. Some property is publicly owned and awaiting urban redevelopment, but other properties remain vacant because their location and size do not justify the expense of redevelopment. An understanding of the economic viability of existing buildings in the urban core, especially older rented structures, is necessary in order to anticipate future demolitions and the production of vacant land. Hence, this research will concentrate on cities having a significant number of old residential structures.

Specific objectives: (1) Evaluate existing research on urban land-use change and the effects of urban land use on the distribution and function of the urban forest. (2) Evaluate the distribution of and demand for selected land uses in older American cities. A first stage objective will focus on the creation of vacant land in the urban residential core. Particular attention will be given to cities having a large quantity of vacant land or a significant number of obsolete or near-obsolete structures, or cities where a significant proportion of the housing was constructed before 1945. This objective deals with, but is not limited to, the identification of sites for possible urban afforestation. (3) Construct a model of recent and future urban land-use change that incorporates the economic, social, and political variables necessary to understand this phenomenon. This includes the consideration of urban land values, demand for various categories of land uses and locations, the demand for certain residential locations, property taxes, public intervention in the land market, and the increasing cost of energy as it affects the distribution of land uses through transportation and the economic viability of existing buildings.

Silvicultural systems for nonindustrial private forest lands in an urbanizing county

The Brandywine watershed in southern Pennsylvania provides special opportunities for studying the management of Nonindustrial Private Forests (NIPF's) in urbanizing areas. These lands contain valuable timber resources that could help alleviate predicted timber supply shortages in the future. Nationwide, some 296 million acres of commercial forest land, which amounts to 58 percent of the total commercial forest, are owned by private individuals or nonindustrial corporations. Many of these owners are located on the fringes of metropolitan regions and seek to retain and manage their forestlands in the face of growing pressures for urban land development. While timber is a valuable product of these lands, other benefits, such as wildlife habitat, nature preservation, visual aesthetics, and both passive and active recreation, must be incorporated into the list of management objectives.

Chester County, on the Brandywine watershed, has attributes valuable for studying management of NIPF's: (1) the area is almost completely owned by private individuals in relatively small parcels, (2) the ownership objectives are characteristic of the diversity that could be expected in most regions of the country, (3) through the efforts of the Brandywine Conservancy, there is an enhancement of appreciation of the value of a true conservation ethic in the area, and (4) various easements on the floodplain of the Brandywine preclude development, and render forest management an attractive alternative on sites subjected to periodic flooding. Chester

County is the site of a multi-disciplinary urban forestry project; this study will constitute the silvicultural core of that larger project.

Specific objectives: The overall purpose of this study will be to develop flexible, usable silvicultural plans to guide the long-term management of forest stands representative of those in the area and characteristic of the ownership objectives that exist in the area. The specific goals of this study will be as follows: (1) characterize the forest stands of the region by site class, age, condition, and species composition; (2) identify the range of ownership objectives for lands held for long-term forest management purposes; (3) develop scientifically based silvicultural plans covering entire rotations that account for the diversity of ownership goals in the area, perhaps by individual stand type.

Structure, development, and silviculture of mixed stands in a suburban region

The general purpose of the research is to improve the understanding of the structure and development of complex mixtures of hardwoods so that their silvicultural management can proceed on a sound basis within the context of a suburban region. The forests that develop on the deep soils of the Brandywine Valley between Philadelphia and Wilmington are deemed to be some of the finest existing examples of the Appalachian Forest formation, which extends from New England to Alabama and covers much of the Boston-Washington Megalopolis. There are few forests outside the humid tropics that are more complicated and, therefore, more difficult to understand. The existing forests do not seem to fit the simple concept of pure (single species) even-aged stands in which all the trees have their crowns in a single canopy. Neither do they commonly seem to fit the other long-standing interpretation of complexity of forest-stand structure; that is, the concept of the uneven-aged stand, which would have to consist of small groups of trees with very different total heights for each group.

Specific objectives: (1) Test the hypothesis that these forests consist of even-aged aggregations of trees (not necessarily even-aged stands), which develop in a vertically stratified structure in which the different species tend to occupy different strata by reason of different regimes of growth in height. (2) Determine the extent to which the vertical arrangement of foliage in certain typical stands represents adaptations that lead toward optimum use of available light by the forest vegetation. (3) Determine how the distribution of tree diameters and other measurable attributes of even-aged stands or aggregations change with increasing age. (4) Construct estimated yield tables of timber volume for different stand ages. (5) Assist other cooperators with the formulation of schemes of silvicultural management appropriate to the forests of the Brandywine Valley and the objectives of the various kinds of owners of such forests.

Construction and review of urban forest management models for climate, energy, and attractiveness in Dayton, Ohio

Northeastern cities face three environmental problems that can be solved in part by urban forest and vegetation management: (1) to minimize aggregate urban energy consumption, (2) to ameliorate the urban microclimate and reduce air pollution, and (3) to improve the general attractiveness of the central city to both residents and transients. In order to develop a management plan for urban forest vegetation that can contribute to the solution of these problems, it is necessary to construct models that will estimate the quantitative effects on (1), (2), and (3) of any given urban forest configuration and management strategy. The construction and review of these models must take place in a practical context that will enhance the chances of any resulting plan being implemented.

The general purpose of this study is to develop models necessary for urban forest management in Dayton, Ohio. The plan which results must be constructed in close association with the scientific limitations and economic, political and social realities of the city. The study will fund one scientist who will work in conjunction with the City Manager's Office for 1 year.

Specific objectives: Construct and review a model or models that test(s) the effectiveness of different urban forest configurations (and associated management strategies) in reducing aggregate urban energy consumption, ameliorating the urban microclimate, reducing central city air pollution, and enhancing the general attractiveness of the city.

Development of descriptive successional models for forest communities in an urban county, Central New York

Forest community succession in urban counties is poorly understood because of a complex pattern of interference by human activity. Yet, the planning for management of urban forest communities requires knowledge of what forest conditions will be in 20-25 years. Woodlands around metropolitan areas will experience more intensive use in the near future as rising energy costs make these forest types more attractive for recreation, wood production, and a number of greenspace resource uses. Managers must be able to predict community attributes of at least the most important types. The purpose of this study is to develop the scientific knowledge for this predictive capability.

The study will begin with a classification of the more important forest communities in Onondaga County, New York. The taxonomy will employ dynamic criteria pertinent to other areas in Central New York. The methodology will be developed so as to make it applicable to an even larger universe of cases dealing with urban or urbanizing counties. For this type of study a county unit is logical from the standpoint of inventory and sampling, as well as being appropriate for inclusion in a county land-use and resource management plan.

Specific objectives: (1) Evaluate existing classifiction schemes that may be applicable to the Onondaga County situation. (2) Produce a taxonomy of forest communities in Onondaga County, New York, from existing field plots, surveys, and air photos, and refine this taxonomy with additional field sampling and interpretation during the period of the study. (3) Develop descriptive successional models for the important forest communities based on an understanding of biologic and anthropogenic factors. The models will be constructed to accommodate quantification with additional study.

Study to identify and characterize selected client groups for urban forestry knowledge (See Koten and Rowntree, p. 66.)

Integrating urban forestry options into comprehensive land-use planning: modeling and implementation

and

Integrating urban forestry options into comprehensive land-use planning: concepts, methods, and principles

Comprehensive land-use planning now occurs at city, county, regional, and statewide scales; and urban forestry science has advanced to the point where it is now possible to incorporate strategies for managing urban forests and associated vegetation into the comprehensive land-use planning process. In order to do this, it is necessary to identify and develop appropriate concepts, principles, and methods that will integrate urban forestry knowledge with land-use planning at different scales of operation.

Concepts and models of spatial and temporal patterns of urbanization over a planning period of 20 years must be developed along with the ability to account for perturbations due to policy shifts and changes in the distribution of location costs. A range of urban forest options that can produce varied benefits to present and future populations must be modeled in terms of costs and who will bear those costs. Methods of dealing with various degrees of uncertainty in all areas of the planning and management process should be incorporated into these models. Legal, jurisdictional, and institutional measures can be evaluated to determine the most effective means of implementing sound programs of urban forest/vegetation management and land-use control.

Specific objectives: For the first study: (1) Model future land-use changes in the presently undeveloped area lying between Philadelphia, PA, and Wilmington, DE, for the period 1980-2000. Refine this model so that it can be applied to other large metropolitan regions. (2) Evaluate existing environmental impact models to determine which provide the resources for building a new model that can predict two-way interactions between urban forest ecology and urban land uses. (3) assess existing legislation, institutional arrangements, and jurisdictional constraints bearing on the integration of urban forestry options with comprehensive land-use planning. For the second study: (1) Evaluate concepts relating to spatial and temporal development patterns over the next 20 years for the Philadelphia-Wilmington metropolitan area in such a way that these concepts can be applied to other large urban regions in the United States. (2) Identify probable influences on development patterns in the Philadelphia-Wilmington region that could have spatial or temporal implications for the urbanizing process. These influences could be, but are not limited to, policies bearing on land use or costs (such as energy, building, or transportation) of spatial location. (3) Construct a conceptual and methodological framework that identifies and relates questions and issues bearing on the integration of urban forestry into the comprehensive land-use planning process. These questions and issues deal with, but are not limited to, the types of urban forestry options that can be incorporated into land-use planning at the county or regional scale of operation, and the costs associated with each option. In particular, methodologies for incorporating nonpriced benefits such as wildlife habitat and aesthetic values of woodlands must be identified and assessed. (4) Develop a system for understanding the distribution of both priced and nonpriced benefits and costs of urban forestry options among present and future landowners, local communities and the larger public interest. This system can be seen as interfacing with a system of existing and proposed institutional, jurisdictional, and legal means of implementing urban forestry options.

Comparative profiles of the operations and information utilization of urban forestry programs

The need for more reliable technology transfer mechanisms among operational sectors of urban forestry is being increasingly recognized. Research agreement #42-269 ("Study to Identify and Characterize Selected Client Groups for Urban Forestry Knowledge") attempts to identify some of the factors bearing on information transfer. To complement this identification process, the present study proposes to collect, through a survey, information on the organization and operations of a sample of urban forestry programs that are broadly representative of the full range of the most active and successful programs. This will include an overview of all published material as well as on-site interviews or surveys of people involved with the administration of the various programs. We hope that information regarding the organization structure, the relationships with other groups (both governmental and private), and the experiences of different programs can be compared and analyzed so as to reveal the effect various factors, including technical information, have on the success of a program.

Specific objectives: (1) Identify and measure the relative potency of the economic, political, social, and administrative factors that determine the effectiveness of urban forestry programs in a sample of eight sites in the conduct and effectiveness of these eight urban forestry programs. (2) Identify technical information needs that can be met by planning and management research in urban forestry, from this examination of eight programs.

INDEX OF RESEARCH IN PROGRESS

1.0 Benefits
- Cordell 17
- Flynn 17

1.1 Physical
- Heisler 18

1.11 Climate
- Flynn 17
- Heisler-Miller 18
- Miller 19
- Potts-Herrington 66
- Wolfe 19

1.12 Noise
- Mulligan 38
- Read 20
- Reethoff 21

1.13 Air Quality
- Smith 22

1.14 Waste Disposal
- Gilman 22

1.15 Hydrology
- Corbett 23

1.16 Water Supply
- Black-Bradzauskas 23
- Corbett 24

1.2 Economic

1.21 Energy Conservation
- Arens 24
- Cordell-Mixon 26
- Dewalle 26
- Heisler-Miller 18
- Miller 19

1.22 Utilization
- Walker 28

1.23 Tree Value
- Farber 29
- Paine 30

1.24 Land Value
- Farber 29

1.3 Social

1.31 Recreation
- Dawson 30
- Hayward-Jones 31
- Holecek 32
- Palmer-Hayward 32
- Peterson 33
- Young 34

1.32 Wildlife
- Van Druff 34

1.33 Aesthetics
- Kaplan-Kaplan 35
- Lewis 36

1.34 Behavior
- Kaplan-Kaplan 35
- Kielbaso 37
- Marans 37
- Mulligan 38

2.0 Culture and Protection

2.1 Species Selection

2.11 Breeding
- Barker 39
- Cunningham 39
- Holmes 41

Karnosky 44
Little, S. 45, 46
Mower 47
Redenbaugh et al. 51
Santamour 47
Steiner 49
Valentine 52

2.12 Selection

Anderson-Mixon 49
Cordell-Mixon 49
Cunningham 39
Gilman 22
Hilliard 50
Karnosky 44
Macbeth 50
Mower 47
Redenbaugh et al. 51
Santamour 47
Spry 51
Steiner 49, 65
Valentine 52
Vrecenak 53
Wagar 53

2.13 Propagation

Steponkus-Good 54
Wagar 53

2.2 Planting, Maintenance, and Silviculture

2.21 Site Analysis

Anderson-Mixon 49

2.22 Site Modification

2.23 Care and Maintenance

Cunningham 39
Ham-Dunn 58
Harris-Mills 54
Harris-Leiser 55
Holmes 41
Paine 30
Shaw 56
Steponkus-Good 54
Tukey 57
Wagar 53

2.24 Removal/Harvesting

Walker 28

2.25 Soils

Ham-Dunn 58

2.3 Protection

Gilman 22
Manion et al. 58

2.31 Insects

Berisford, Y.-Hunter 58
Berisford, W. 59
Johnson 59, 60, 61
Johnson-Zepp 60
Lanier et al. 61
Shaw 56
Valentine 52
Zepp 62

2.32 Disease

Berisford, Y.-Hunter 58
Berisford, W. 59
Cunningham 39
Holmes 41
Karnosky 44
McCracken 62, 63
Shaw 56
Valentine 52

2.33 Fire

2.34 Vandals

2.35 Damage from Development

Mader-Weeks 63

2.36 Pollution

Lassoie 64
Steiner 65

2.4 Physiology

Cunningham	39
Heisler	18
Holmes	41
Lanier et al.	61
Miller	65
Potts-Herrington	66
Santamour	47
Spry	51

3.0 Management and Planning Environment

Cordell	17
Flynn	17

3.1 Communication

3.11 Technology Transfer

Koten-Rowntree	66
Magill	67
Wagar	53

3.12 Information Retrieval Systems

Magill	67
Richards-Stevens	67

3.13 Information and Education

Montcrief-Stynes	68

3.14 Career Development

3.15 Research Needs

3.2 Finance/Legal/Political

3.21 Ordinances

3.22 Budget/Finance

3.23 Registration/Certification

3.24 Political Considerations

3.3 Urban Development/Design

3.31 Design

Heisler-Miller	18
Richards-Stevens	67

3.32 Land-Use Planning

Farber	29
Corbett	23, 24
McBride-Jacobs	68
Read	20
Richards	69
Richards-Tessier	69
Sanders-Rowntree	70
Strong et al.	71

3.33 Urban/Wildlands Conflicts

3.34 Program Design and Development

Perry	71
Richards-Stevens	67
Richards-Tessier	69
Strong et al.	71

3.4 Inventory

Shaw	56

3.41 Vegetation

Shaw	56

3.42 Wildlife

3.43 Pests

3.44 Soils

3.45 Water

3.46 Cultural

URBAN FORESTRY RESEARCH IN THE SOUTH (1.0/3.0)

CORDELL, Harold K.
Southeastern Forest Experiment Station
USDA Forest Service
Forestry Sciences Lab
Carlton Street
Athens, Georgia 30602

The research project will encompass two problem areas: (1) identification and evaluation of the social and physical benefits from urban forest management and (2) development of guidelines for establishing and managing urban forest vegetation. Problem 1 will involve both economic and psychological measurement techniques and theory application. Problem 2 will be approached strictly from a biological basis. Both problem areas will be pursued from the premise that experience with problems already existing in heavily populated regions and improved urban forest management in the developing South can help prevent problems in other heavily populated, urbanized regions.

A STUDY OF THE RELATIONSHIP BETWEEN THE URBAN HEAT ISLAND AND THE SPATIAL DISTRIBUTION OF THE URBAN FOREST (1.0/1.11/3.0)

FLYNN, John (Lee P. Herrington)
SUNY College of Environmental Science and Forestry
Syracuse, New York 13210

(315) 473-8642

Sponsored by: USDA Forest Service, Northeastern Forest Experiment Station, Syracuse, New York

Starting and completion dates: 1978-1979

The Urban Heat Island (UHI) occurs throughout the year in most urban areas. It varies both spatially and temporally in magnitude and form. It is caused primarily in the nonwinter months, by excessive heating of urban air by the ground surface. This is due to the alteration of the energy budget within urban areas such that the net radiation gain in the daytime increases over that of rural areas. Essentially, evaporative surfaces (vegetation) with low heat capacity and low conductivity characteristic of rural areas have been replaced by nonevaporative surfaces (building materials) with high heat capacity and high conductivity characteristic of urban areas. This results in increased storage and sensible heat components in the energy budget. The energy budget and subsequently the magnitude of the temperature anomally (UHI) of an area will be determined by the distribution of surface types and the partitioning of their energy characteristics. This study quantifies the spatial distribution of vegetated and non-vegetated surface types within the urban areas, and explores the relationship between intraurban variance of the UHI or local thermal environment and spatial pattern, land use, population, and topography.

STOMATAL RESISTANCE OF URBAN TREES (1.1/2.4)

HEISLER, Gordon M.
USDA Forest Service
Northeastern Forest Experiment Station
The Pennsylvania State University
University Park, Pennsylvania 16802

(814) 863-1935

The evaporative heat sink provided by transpiration from urban trees is probably an important part of urban mesoscale energy budgets. However, there is little information about the rates of transpiration of urban trees. Measurements of stomatal resistance of leaves can indicate transpiration rates and also identify physiological stress in urban trees due to limited moisture availability. Stomatal resistance of two tree species, green ash (*Fraxinus pennsylvanica*) and red maple (*Acer rubrum*), planted in a parking lot will be measured with a diffusion porometer. Simultaneous measurements of soil and atmospheric variables will be analyzed to determine effects of these variables on diffusive resistance.

CHARACTERIZATION OF WINDBREAKS FOR THE NORTHEAST (1.11/3.31/1.21)

HEISLER, Gordon M. and MILLER, David R.
USDA Forest Service
Northeastern Forest Experiment Station
The Pennsylvania State University
University Park, Pennsylvania 16802

Wind tunnel modeling can be used to study the relative effectiveness of different tree windbreaks and windbreak locations for reducing house space heating energy use. The value of wind tunnel studies would be enhanced if windbreak models could be made to represent more assuredly windbreaks at full scale. Similarity between model and full scale can be achieved by parameters of permeability derived by comparing wind profiles in the lee of shelterbelts with upwind profiles. This study will include a search of existing literature for such wind profile data and calculation of permeability parameters from that data. Additional wind profile data will be collected in the field to complete the picture for windbreaks of the northeastern United States. Windbreaks will be described in terms of species, size arrangements, and permeability parameters including, CD, the drag coefficient.

ENERGY BALANCE AND MICROCLIMATE OF THE FOREST-URBAN EDGE (1.11)

MILLER, David R.
University of Connecticut
Storrs, Connecticut 06268

Starting and completion dates: December 1977-1978

The components of the two dimensional energy budget at a hardwood forest edge are modeled and analyzed. Field experiment results indicating the magnitude of the various energy budget components at forest-development interfaces are presented. The usefulness and application of this type of knowledge to aid in minimizing the local environmental impact of developments in forested areas is discussed.

CHARACTERIZATION OF WINDBREAKS FOR THE NORTHEAST (1.11/1.21)

MILLER, David R.
University of Connecticut
Storrs, Connecticut 06268

Starting and completion dates: 1979-1979

To describe porosity parameters with geometry similar to that necessary for winter protection of houses in the northeastern United States.

CHANGES IN URBAN PHYSICAL MORPHOLOGY (1.11)

WOLFE, Judith L. (Rowan A. Rowntree)
SUNY College of Environmental Science and Forestry
Syracuse, NY 13210

(315) 473-8673

Sponsored by: Northeastern Forest Experiment Station, Urban Forest Research Project, Syracuse, NY

Starting and completion dates: June 1978--October 1979

1.12 Noise

This study deals with the usefulness of one parameter of land use, --urban physical morphology, the spatial arrangement of structures, streets and vegetation --in the understanding of the functional relationship between the urban land-use system and the urban forest system. The relationships between urban physical morphology, changes in the distribution of the urban forest and the modification of the street-level microclimate in the Central Business District of the Syracuse, New York, study area, are examined with reference to their impact on the user population.

Response to the changes in the street-level microclimate of the study area is considered through a thermal balance for an individual. The greatest changes seem to occur in insolation regimes received at ground level and in increased wind speeds over the years. Data from the U.S. Census (1950-70) indicate that the user population may be different from that in the past, being characterized by increasing age and lower current income. This study is relevant to findings that the incidence of heart attacks increases in cold weather for older people and that the ability to deal with weather extremes resulting from changes in physical morphology diminishes with poor nutrition, a condition which is often associated with people living on lower incomes.

The study suggests that a class of American cities, with Syracuse as an example, has produced during the last 30 years urban core environments that involve higher levels of human thermal stress.

TREES AND SHRUBS - BARRIERS FOR NONBENEFIT CONTROL (1.12/3.32)

READ, Ralph A.
Rocky Mountain Forest and Range Experiment Station
University of Nebraska
East Campus, Forestry Sciences Lab.
Lincoln, Nebraska 68503

Trees, shrubs, and solid barriers used in various combinations effectively shield highway rest areas, parks along interstates, residential areas, and urban areas from the noise of normal passenger cars as well as truck traffic. Reductions of 4 to 7 decibels (about two-thirds as loud) are possible with dense plantings of shrubs with taller trees. A further 2 to 3 decibel reduction may be obtained by the addition of solid barriers.

Tree improvement research by the author applies to developing species (for example, Scots pine (Pinus sylvestris), Douglas-fir (Pseudotsuga menziesii), eastern white pine (Pinus strobus), Austrian pine (Pinus nigra), and red pine (Pinus resinosa) resistant to diseases and insects, and adaptable to the plains environments for practical use.

AN ANALYSIS OF THE IMPACT OF FORESTS ON THE CONTROL OF THE URBAN ACOUSTIC ENVIRONMENT (1.12)

REETHOFF, Professor Gerhard
213D Engineering Unit E
The Pennsylvania State University
University Park, Pennsylvania 16802

(814) 865-2761

Sponsored by: The Consortium for Environmental Forestry Studies

Starting and completion dates: June 1, 1978-June 1, 1979

The Noise Control Laboratory of The Pennsylvania State University has conducted research in forest acoustics sponsored by the Pinchot Institute for 4 years. Substantial contributions under Pinchot Institute sponsorship have also been made by the State University of New York College of Environmental Science and Forestry at Syracuse. Many others have contributed to this research effort, notably Professor David Cook of the University of Nebraska under U.S. Forest Service sponsorship. In general, the goals of the research projects, as originally proposed, were more than adequately met. In most cases, however, considerably larger volumes of data were collected than could be completely analyzed with the funds and the manpower available at the time. Numerous publications have resulted from these past research efforts and have resulted in considerable public interest.

The findings to date by the various researchers are sometimes contradictory. We believe, however, that the data collected in the research efforts were very carefully taken and that much can be gleaned from further extensive analysis. We believe this to be essential at this time to provide a better assessment of the role of vegetation in the control of noise in the urban environment.

This year's research effort by the Noise Control Laboratory at Penn State under the sponsorship of the Pinchot Institute is devoted primarily to thorough analysis of previous data, resolution of discrepancies, and the preparation of publications that will disseminate the best available information to the scientific community and to decision makers.

Citations of publications produced from this project:

Reethof, G. and O. H. McDaniel. 1980. Acoustics and the urban forest. In Proc. National Urban For. Conf. 1978, Washington, D.C.

Borthwick, J., H. Halverson, G. M. Heisler, O. H. McDaniel, and G. Reethoff. 1978. Attenuation of highway noise by narrow forest belts. Final Rep. Fed. Highw. Adm., FHWA-RD-77-140.

Carlson, David E. 1978. Theoretical and experimental analysis of the acoustical characteristics of forests. Unpublished M.S. Thesis.

PARTICULATE CONTAMINATION AND URBAN TREES (1.13)

SMITH, W. H.
Yale University
New Haven, Connecticut 06520

The most damaging levels of air pollution are reached in industrial and urban areas. Atmospheric contaminants in metropolitan areas include both particulate and gaseous pollutants. Since trees have evolved in the presence of numerous materials presently considered air pollutants, and since trees are frequently abundant in urban areas, it has been speculated that trees may function as effective sinks for trace contaminants. Mechanisms for removing particulate matter may include sedimentation on tree surfaces, impaction on tree surfaces and precipitation transfer to tree surfaces. Mechanisms for gaseous removal may include uptake via plant pores and surface absorption. Sufficient potential for this sink function is indicated to justify consideration of this amenity function in tree selection and breeding programs for metropolitan trees.

VEGETATING THE COMPLETED SANITARY LANDFILL (1.14/2.3/2.12)

GILMAN, E. F. (Ida A. Leone)
Rutgers University
New Brunswick, New Jersey 08903

Sponsored by: U. S. Environmental Protection Agency

Starting and completion dates: 1978-1979

During the last 5 years, many attempts to revegetate completed sanitary landfills have been undertaken throughout the United States, with various degrees of success. This study was undertaken to determine which woody species, if any, can maintain themselves in an anaerobic landfill environment; to investigate the feasibility of preventing landfill gas from penetrating the root zone of selected species by using gas barriers; to identify the (those) factor(s) which is(are) most important in maintaining adequate plant growth on completed sanitary landfills. Of the 19 species growing on a 10-year-old landfill for the past 2 years, certain species have tolerated the landfill better than others. Of five gas barrier systems tested, three prevented landfill gas from penetrating into the root zones of the trees.

EFFECTS OF SUBURBAN DEVELOPMENT ON WATERSHED HYDROLOGY (1.15,3.32)

CORBETT, Edward S.
USDA Forest Service
Northeastern Forest Experiment Station
The Pennsylvania State University
University Park, Pennsylvania 16802

Suburban encroachment on municipal watersheds and other forested and agricultural lands is common and affects both water quality and quantity. This study will evaluate changes in rainfall-runoff relationships in small watersheds during suburban encroachment, and changes in water quality as a function of land-use change. A portion of this work is being conducted through cooperative studies at Rutgers University and the Baltimore, Maryland, Municipal Watershed.

PARKING LOT RUNOFF IMPACT ON WATER QUALITY IN A SUBURBAN STREAM (1.16)

BLACK, Peter and BRADZAUSKAS, Karl
SUNY College of Environmental Science and Forestry
Syracuse, New York 13210

(315) 473-8644

Sponsored by: The Consortium for Environmental Forestry Studies

Starting and completion dates: April 1, 1978-September 1, 1979

The purpose of this study is to determine the effects of parking lot runoff and stream channelization on instream water quality parameters in the vicinity of a suburban shopping mall.

The literature contains no reference to the impacts on temperature and other water quality parameters when a natural stream receives parking lot runoff waters, although it is suggested that temperature increases during storm runoff periods. The existing opportunity and some initial measurements made during the summer of 1977 indicated that a highly successful study may be conducted within a short period with minimal resources. Primary measurements were made with a YSI Salinity-Conductivity-Temperature meter, and air temperature, stream stage, and weather conditions were recorded. At intervals pH, CO, CO_2, NO_3, PO_4, alkalinity, hardness, silica, iron, and chlorides were tested with a LaMotte Chemical Company Field Test Kit according to standard methods.

The study site meets prime criteria for such a study: it isolates surface and subsurface runoff from the parking lot of a suburban mall; the stream may be readily monitored (1) where it is in its natural state, (2) where it receives surface runoff, and (3) where it is concrete-lined and receives surface and subsurface runoff. It is readily accessible, and down wind from the principal investigator's home and work locations. This location will enable early warning of storm events. The compactness of the site permits complete manual monitoring of primary quality parameters on a 15-minute cycle.

Sampling will be on three bases at the sites indicated: a) a long-interval background level; b) an intense temporal schedule during storm events; and c) a widespread watershed quality survey.

The study will be coordinated with another project involving application of parking lot runoff waters to soil columns and with a study involving the quality of the runoff water.

MANAGEMENT OF MUNICIPAL WATERSHEDS (1.16/3.32)

CORBETT, Edward S.
USDA Forest Service
Northeastern Forest Experiment Station
The Pennsylvania State University
University Park, Pennsylvania 16802

Multiple-use under heavy demand characterizes municipal watersheds. Their managers have the primary responsibilities for producing an income from timber growth and of meeting recreation demands to the extent possible. Many municipal watersheds constitute the principal forested area within the urbanized domain. Studies are being conducted to evaluate the impacts of municipal watershed land management practices on water quality and aquatic habitats. The effects of vegetation type conversions on storm flow characteristics, as well as on this work, is being conducted through cooperative studies at Penn State University and at the Baltimore, Maryland, Municipal Watershed.

CONTROL OF THE MICROCLIMATE AROUND BUILDINGS FOR IMPROVING THEIR ECONOMY, UTILITY, AND ENERGY EFFICIENCY (1.21)

1.21 Energy Conservation

ARENS, Edward
Room A 335
Building 226
National Bureau of Standards
Washington, D.C. 20234

(301) 921-3595

Sponsored by: NBS and ASCE

Starting and completion dates: December 1978-December 1980

A task committee of the ASCE subcommittee on architectural aerodynamics has been formed to prepare a state of the art report on the "Control of microclimate around buildings for improving their economy, utility, and energy efficiency." The duration of the task is 2 years. The current members of the task committee are Edward Arens, Jon Peterka of the environmental wind tunnel facility at Colorado State University, Hassan Nagib of the fluid dynamics department at Illinois Institute of Technology, and Douglas Coonley of a private design firm in New Hampshire.

The list of topics to be investigated for possible inclusion in the report are:

Pedestrian acceptability of outdoor built environment.

- tall buildings, stadia, open space
- comfort criteria for cold and hot conditions
- design techniques to assure satisfactory environment

Energy implications.

- whether or not to enclose and condition space (based on comfort characteristics)
- natural ventilation at building and site scales (is it feasible, if so, how?)
- fan efficiency (exhaust and cooling tower)
- infiltration and heat loss (building configuration and site measurement)
- wind data for computer simulation of building energy requirements

Air pollution dispersal.

- exhaust recycling in the immediate vicinity of buildings
- street canyon pollution

Air flow within buildings.

natural ventilation paths
the neutral point as a function of wind and stack effect
infiltration/exfiltration

Wind created noise.

Hazards to aircraft landing in built-up areas.

HOME ENERGY CONSERVATION WITH LANDSCAPING (1.21)

CORDELL, H. K. (USFS) and MIXON, John (Georgia Forestry Commission)
Forestry Sciences Laboratory
Carlton Street
Athens, Georgia 30602

(404) 546-2451

Sponsored by: USDA Forest Service and Georgia Forestry Commission

Starting and completion dates: November 1, 1978-December 31, 1980

Determination of dollars saved, energy saved, and homeowner's and resident's comfort levels under various landscape conditions in the southern states, especially Georgia.

USE OF URBAN VEGETATION TO CONSERVE HOME HEATING AND COOLING ENERGY (1.21)

DEWALLE, David
School of Natural Resources
The Pennsylvania State University
Room 106
Land and Water Research Building
University Park, Pennsylvania 16802

(814) 863-0291

Sponsored by: The Consortium for Environmental Forestry Studies

This abstract is a summary of several completed and ongoing research projects conducted at Penn State. Research here has been focused on the use of shade trees and windbreaks to reduce energy consumption for home air conditioning and heating. Most field studies have involved using small mobile homes to assess vegetation effects. A unique method of monitoring air infiltration has also been used to monitor heat exchange by air movement through cracks and openings in a home. Completed projects resulting from this research are:

1. The effects of forest vegetation on microclimate within the metropolitan complex, 6/73 to 8/76. Experiments were conducted to determine the effects of a pine forest on home heating energy needs. Results were extrapolated to determine the effect of a deciduous forest and shelterbelt.

2. Forest vegetation effects on home energy consumption, 7/76 to 6/77. Further mobile home experiments to determine the effects of deciduous grove and pine forest on energy needs for home heating and cooling.

3. Problem analysis for energy conservation using urban forests, 6/77 to 12/77.

Two other ongoing projects are:

4. Generalization and optimization of vegetation effects on energy consumption for residential space conditioning. Analysis of mobile home data from earlier projects to determine optimum year-round vegetation arrangements and effects of varying home characteristics.

5. Placement of coniferous tree shelterbelts to reduce air filtration and energy consumption for space heating in a small mobile home. Field study with a white pine windbreak to determine optimum position upwind from home for energy savings.

Citations of publications produced from this study:

Jacobs, R. E. and D. R. DeWalle. 1977. Effects of forest vegetation on energy consumption for trailer heating. Final Rep., USDA For. Serv., Pinchot Inst., PL 85-934, 61 p.

DeWalle, D. R. and R. E. Jacobs. 1977. Trees around properties cut home heating costs. Pa. State Univ., Coll. Agric., Sci. Agric. 24(4).

DeWalle, D. R. and R. L. Cowan. 1978. Effects of coniferous and deciduous forest vegetation on energy consumption for trailer heating and cooling. Final Rep., USDA For. Serv., Pinchot Inst., Grant no. 23-765, 51 p.

1.22 Utilization

DeWalle, D. R. 1978. Residential energy conservation using urban trees and forests, a problem analysis. Final Rep., USDA For. Serv., Pinchot Inst., Coop. Agreement 23-906, 36 p.

DeWalle, D. R. 1978. Trees for shelter and shade. Sch. For. Resour., Coop. Ext. Serv., Pa. For. Resour., No. 53, 4 p.

DeWalle, D. R. and E. P. Farrand. 1978. Windbreaks and shade trees--their use in home energy conservation. Pa. State Univ., Coll. Agric., Agric. Ext. Serv., Spec. Circ. 245, 8 p.

DeWalle, D. R. 1978. Mobile home energy costs conserved with shade trees. Pa. State Univ., Coll. Agric. Sci. Agric. 26(1):16.

DeWalle, D. R. 1980. Manipulating urban vegetation for residential energy conservation. In First Natl. Urban For. Conf. Proc. 1978, Washington, D.C.

LIABILITIES TO ASSETS--ORGANIC MULCHING (1.22/2.24)

WALKER, David K.
Rt. 1
c/o Tommy's Inn
Hayesville, North Carolina 28904

(No telephone)

Sponsored by: Some work done at Georgia Tech., but not funded or sponsored by them. Present work sponsored by self only.

Starting and completion dates: Basic program began in 1970--present program started on January 1, 1979.

Studies have shown very successful returns when wood chips have been used as an organic mulch. Today while most of the tree is used effectively, the tops and trimmings from utility right-of-way clearing are commonly dumped in landfills rather than put to any useful efforts. This practice occurs both in urban areas and country locations. The true value and many uses of this material resource have yet to be realized.

Present work is aimed at the private small land owner (less than 20 acres) who would like to improve his land and gain a return from his investment. Most clearing operations call for burning off the excess, in rural areas where burning laws are not critical. Efforts will be made to clear acreage of unwanted timber not successfully producing quality material. All salvageable timber, pulpwood, and firewood will be removed, and the balance will be run through a chipper. These chips will then be placed so as to check the growth differential between chipped and unchipped areas.

At present the proposed varieties to be tested will be poplar and white pine since these are the most commonly planted trees in the local forestry incentive program of this area. In addition the response of some fruit tree varieties and some Christmas tree stock will be checked.

Past research has revealed superior growth of five varieties of hardwoods (during the summer and fall of 1978, 3 to 4 feet of growth was produced during an abnormally dry period and without water or fertilizer being applied).

Hopefully the project will yield a better application technique for heretofore wasted material, producing better and faster growing timber, while erosion, moisture loss from the soil, and fire control tests show good results. Teaching aids could then be devised for local schools and interested land owners who would be looking for ways to better manage their property.

Some assistance on the costs of clearing and replanting will come from the North Carolina State Forestry Commission. I hope to keep both written and pictorial information on hand for those who wish it.

Media coverage produced from this project:

1. Useful woodchips solve several campus problems. Park Maintenance, September 1973.

2. Tree talk. Clayton County Daily News, February 13, 1976.

3. Saving dollars with woodchips. Grounds Maintenance, June 1977.

4. Ice storm waste becomes needed resource. Georgia Forestry, June 1977.

5. Tree talk. Channel 5 TV, Atlanta, January 1976--15 minute color tape.

6. Today in forestry. Channel 2 TV, Atlanta--10 minute color tape.

ASSESSING THE ECONOMIC EFFECTS OF FOREST RESOURCE PROJECT WITHIN A LOCALIZED REGION (1.23/1.24/3.32)

FARBER, Marion (Bethune, James)
University of Connecticut
Storrs, Connecticut 06268

Sponsored by: McIntire-Stennis, University of Connecticut Experiment Station

Starting and completion dates: 1980-1981

Program adapted for portable computer terminal to provide economic impact information to local planners.

EVALUATION OF ACCIDENT HAZARD ASSOCIATED WITH TREES (1.23/2.23)

PAINE, Lee A.
Pacific Southwest Forest and Range Experiment Station
Biology and Control of Diseases Research Work Unit
Berkeley, California 94701

Sponsored by: PSW Station, Urban Forestry Research

Starting and completion dates: Work in progress--1980

Both urban and nonurban land managers and owners find that injuries, fatalities, and losses from hazardous tree accidents are unacceptably high. Because of the seemingly random occurrence of such accidents, no adequate guidelines were ever made available for the evaluation and reduction of hazards to available levels without unnecessary destruction of needed trees. The function of this study is to develop research information and procedures for economical control of hazards. This is particularly important since accidents have been increasing in proportion to the rising use of sites, and dollar costs per accident are increasing even more rapidly.

Data are being collected nationally from all types of sites subject to tree accidents. With new computer programs, the data can be analyzed with respect to tree species, class of failure, tree diameter, associated defects, environmental conditions, type of site, losses, and other factors.

RECREATIONAL IMPACTS ON FOREST COMMUNITIES OF HIGH SCIENTIFIC, EDUCATIONAL AND NATIONAL-HISTORIC VALUE IN THE CHICAGO METROPOLITAN AREA (1.31)

DAWSON, Jeffrey O.
University of Illinois
211 Mumford Hall
Urbana, Illinois 61801

(217) 333-0105

Sponsored by: USDA Forest Service, North Central Forest Experiment Station, Chicago, Illinois

Completion date: September 1, 1980

1. Assess recreational disturbances in selected unique forest sites in the Chicago metropolitan area.

2. Develop effective management guidelines to ameliorate such disturbances.

EVALUATING VISITOR'S EXPERIENCES AT AN OUTDOOR HISTORICAL MUSEUM (1.31)

HAYWARD, Geoffry and JONES, C. Dalton
The Environmental Institute
Blaisdell House
University of Massachusetts
Amherst, Massachusetts 01003

(413) 545-0648

Sponsored by: Subcontract from the Old Sturbridge Village's grant from the National Endowment for the Humanities (NEH)

Starting and completion dates: January 1978-July 1978

This study supported work by Old Sturbridge Village (OSV) in preparing for the development of a new interpretive program for their outdoor museum of a 'living' 19th Century New England Village. The research developed a framework for investigating how the visitors to OSV perceive and experience the village. The principal question addressed was, How is the visitor's experience of OSV inhibited or facilitated in terms of these key issues: (a) getting a sense of going back in time, (b) perceiving the museum as a community rather than a series of indoor/outdoor exhibits, (c) gaining specific information about artifacts or typical activities of the era portrayed by OSV, and (d) developing a sense of the relationship between OSV and the visitor's everyday life and environment.

Citations of publications produced from this project:

Hayward, D. G., C. D. Jones, L. Birebaum, M. L. Miller, and J. F. Palmer. 1978. Investigating the nature of visitor experiences at Old Sturbridge Village. TEI Report No. R-78/12. Environ. Inst., Univ. Mass.

PRIVATELY OWNED FOREST RESOURCES--THEIR ROLE IN MEETING PUBLIC RECREATIONAL NEEDS (1.31)

HOLECEK, Donald F.
Michigan State University
Department of Park and Recreation Resources
East Lansing, Michigan 48824

(517) 355-0823

Sponsored by: USDA Forest Service, North Central Forest Experiment Station, Chicago, Illinois

Completion date: September 1, 1980

1. Identify public recreational needs that can be met on privately owned lands.

2. Assess landowner willingness to produce more recreational opportunities on their lands.

3. Identify and assess public programs whose purpose would be to serve the interests of both urban recreationists and landowners.

PERCEPTIONS OF A NATIONAL SCENIC TRAIL (1.31)

PALMER, James F. and HAYWARD, Geoffry
The Environmental Institute
Blaisdell House
University of Massachusetts
Amherst, Massachusetts 01003

(413) 545-0648

Sponsored by: National Park Service, American Conservation Association and the USDA Forest Service

Starting and completion dates: September 1977 to September 1978

The objectives of this research were: (1) to develop a procedure for inventorying significant scenic, natural, and cultural qualities of a National Scenic Trail, (2) to identify a classification which describes how hikers conceptually organize trail environments, and (3) to determine the qualities hikers use to characterize different trail environments, and (4) to demonstrate ways in which knowledge of hikers' perceptions can be useful to trail managers and planners. Hikers were found to perceive seven types of trail environments: (1) rural towns, (2) countrysides, (3) vistas, (4) backwoods, (5) trailside features, (6) pathways, and (7) logging activity. This classification was developed using a comprehensive set of data provided by ten respondents and tested for reliability using 61 additional respondents. Four principal components were extracted from responses using 24 rating scales to describe a representative sample of trail environments: (1) experiential quality, (2) cultural pattern, (3) extraordinariness, and (4) topographic qualities. Very highly significant differences are perceived among the seven trail types over all four of these perceived themes. While more variation occurs among the perceived experiential qualities, a discriminant analysis suggests that trail types are best characterized by their perceived physical qualities. The data and results of this research are used to relate geographically these perceptions to the trail's resource potential. Particular attention is paid to the potential role which developed environments can play along National Scenic Trails.

Citations of publications produced from this project:

Palmer, J. F. 1979. Perceptual research as a recreation management tool: classifying and describing National scenic trail Environments. Univ. Mass. Unpublished dissertation.

Palmer, J. F. 1979. The conceptual typing of trail environments: tool for recreation research and management. In Assessment of aesthetic research. T. Daniel and E. H. Zube (eds.), USDA For Serv., Rocky Mt. For. Range Exp. Stn.

THE ROLE OF FOREST ECONOMICS IN URBAN RECREATION: BEHAVIORAL ANALYSIS (1.31)

PETERSON, George L.
Northwestern University
Department of Civil Engineering
Program in Urban and Regional Planning
The Technological Institute
Evanston, Illinois 60201

(312) 492-7462

Sponsored by: USDA Forest Service, North Central Forest Experiment Station, Chicago, Illinois

Completion date: March 1980

1. Develop and test hypotheses about the process by which people choose to (or not to) engage in urban recreation activity, with particular emphasis on forest related resources.

2. Develop and test a behavioral model of demand for forest recreation based on an explanation of the recreation choice process.

3. Evaluate the significance of trees, shrubs, etc., in enhancing attractiveness and usefulness of recreation sites.

4. Estimate the value of forest resources in the context of urban recreation, and improve methods for such estimation.

5. Develop methods for evaluating the suitability of potential sites for various recreation activities.

6. Develop and apply methods for assessing the adequacy of available forest related recreation resources in urban areas.

7. Develop and apply design and site location and develop criteria.

USER CHARACTERISTICS AND PREFERENCES FOR URBAN NATURAL AREAS (1.31)

YOUNG, Robert A.
University of Illinois
211 Mumford Hall
Urbana, Illinois 61801

(217) 333-0105

Sponsored by: USDA Forest Service, North Central Forest Experiment Station, Chicago, Illinois

Completion date: September 1, 1980

1. Determine recreation behavior patterns as related to site characteristics of urban natural areas.

2. Determine the characteristics, values, and management preferences of the users of urban natural areas.

THE OCCURRENCE, RELATIVE ABUNDANCE, AND HABITAT AFFINITY OF MAMMALS IN SYRACUSE, NY (1.32)

1.33 Aesthetics

VAN DRUFF, Larry W.
SUNY College of Environmental Science and Forestry
Syracuse, New York 13210

(315) 473-8848

Sponsored by: The Consortium for Environmental Forestry Studies

Starting and completion dates: 1979-1979

The objectives of the study are to inventory the diversity of mammals found in the city, examine their relative abundance, and determine the relationship between the observed diversity and abundance and selected abiotic, biotic, and cultural features of a metropolitan area. Gross cultural features are being measured on a neighborhood basis, while site-intensive vegetative and mammalian assessments are done at one or two selected natural areas in the neighborhoods. The study includes live trapping, vegetative analysis, aerial photo-interpretation, and summarizing U.S. Census Bureau and City agency data.

THE IMMEDIATE NATURAL ENVIRONMENT AND WELL-BEING (1.33/1.34)

KAPLAN, Rachel and KAPLAN, Stephen
University of Michigan
School of Natural Resources
Ann Arbor, Michigan 48109

(313) 764-0426

Sponsored by: USDA, Forest Service, North Central Forest Experiment Station, Chicago, Illinois

Completion date: September 1, 1981

1. Identify categories for classifying natural elements that are meaningful in terms of human perception processes.
2. Develop instruments to measure preferences for urban natural configurations.
3. Determine effect of natural settings on psychological well-being.
4. Identify patterns of preferred natural vegetation.
5. Compare psychological benefits received from urban recreation.

OBSERVATIONS OF SOCIAL AND PSYCHOLOGICAL BENEFITS OF URBAN GARDENING (1.33)

LEWIS, Charles A., Horticulturist
Administrator, Collection Program
The Morton Arboretum
Lisle, Illinois 60532

(Editor's note: The following are excerpts from Mr. Lewis's reply; the title above was supplied by the editor.)

We have strong anecdotal evidence of social and psychological benefits of urban gardening. Recent work by Professors Rachel and Stephen Kaplan, psychologists at the University of Michigan, points to deep seated satisfactions gained from the experience of vegetation. We recognize that these person/plant relationships are not only beneficial but indeed therapeutic, but lack hard data to support this view. I strongly recommend a research project that would study the kinds of benefits and satisfactions that are found in the experience of vegetation in urban settings. The disciplines of psychology and sociology will be able to identify and quantify these benefits. (1.33)

People/Plant Publications by Charles Lewis:

Lewis, Charles. 1979. Can you grow flowers on Avenue D? New York Times, March 28.

Lewis, Charles. 1972. Public housing gardens--landscapes for the soul. In Landscape for living, U.S. Dep. Agric. Yearb. Agric. p. 277-282.

Lewis, Charles. 1973. People-plant interaction: a new horticultural perspective. Am. Hortic. 52(2):18-25.

Lewis, Charles. 1976. People-plant interaction: a man-environment relationship. The Univ. Wash. Arbor. Bull. 39(1):2-9.

Lewis, Charles. 1976. People-plant proxemics: a concept for humane design. In The behavioral basis of design book I selected papers/ EDRA 7. Dowden, Hutchison & Ross, Stroudsburg, PA p. 102-107.

Lewis, Charles. 1977. Human perspectives in horticulture. In Children, nature, and the urban environment, symp. proc. USDA For. Serv. Gen. Tech. Rep. NE-30:187-190.

Lewis, Charles. 1978. A holistic view of horticulture. The Avant Gard. 10(18):

1.34 Behavior

Lewis, Charles. 1980. Urban gardens, landscapes for the soul. First Natl. Urban For. Conf. Proc. 1978, Wash., D.C.

SOCIAL ATTITUDES TOWARD TREES/FORESTS BY VARIOUS USER GROUPS (1.34)

KIELBASO, James
Michigan State University
Department of Forestry
East Lansing, Michigan 48824

(517) 355-0090

Sponsored by: USDA Forest Service, North Central Forest Experiment Station, Chicago, Illinois

Completion date: September 1980

Identify as many attitudes towards trees/forests as possible in hopes of finding those of greatest significance to urban forestry. Comparisons of various parameters will be made to determine if there are differences within the population that merit special attention to different management schemes.

AN INVESTIGATION OF THE IMPACT OF URBAN RESOURCES, EVALUATIONS, AND BEHAVIORS ON THE QUALITY OF URBAN LIFE (1.34)

MARANS, Robert W.
The University of Michigan
Survey Research Center
Institute for Social Research
Ann Arbor, Michigan 48106

(313) 764-8389

Sponsored by: USDA Forest Service, North Central Forest Experiment Station, Chicago, Illinois

Completion date: September 1, 1979

1. Compare social well-being among urban areas with different levels of urban forest resources.

2. Compare social well-being among urban areas with different environmental conditions.

3. Expand knowledge of basic human needs, stress levels, perceptions, and other human behavior in relation to urban forests and environments.

4. Measure the benefits (sociopsychological needs and satisfactions) urban people derive from alternative states of the urban environment.

ASSESSMENT OF SOCIAL BENEFITS OF TREES IN CITIES (1.34)

MULLIGAN, Edward
Department of Psychology
University of Georgia
Athens, Georgia 30602

(404) 542-4983

Sponsored by: USDA Forest Service

Starting and completion dates: January 1, 1979 to December 31, 1979

Purpose is to conduct a series of preliminary or pilot exploratory studies to determine the kinds of social benefits produced by urban trees and the extent to which urban trees affect choice in housing, recreation, and municipal budgeting.

INFLUENCE OF VEGETATION ON MAN'S RESPONSE TO NOISE (1.34/1.12)

MULLIGAN, Edward
Department of Psychology
University of Georgia
Athens, Georgia 30602

(404) 542-4983

Sponsored by: USDA Forest Service

Starting and completion dates: November 30, 1978 to December 31, 1979

Determine whether a person's response to noise--including aesthetic response, performance of communicative and physical tasks, and audition--is modified by characteristics of the environment, especially in the tested areas.

ENVIRONMENTAL INFLUENCE OF SEX EXPRESSION IN ACER GRANDIDENTATUM (2.11)

BARKER, Philip A.
USDA Forest Service
Intermountain Forest and Range Experiment Station
Logan, Utah 84321

Starting and completion dates: 1978, completed

Tree improvement for amenity purposes.

RESEARCH PROGRAM: NORTHERN GREAT PLAINS RESEARCH LABORATORY (2.11/2.12/2.23/2.32/2.4)

CUNNINGHAM, Richard A.
Research Geneticist
USDA, Science and Education Administration
Agricultural Research
North Central Region
Northern Great Plains Research Laboratory
Highway 6 South
P.O. Box 459
Mandan, North Dakota 58554

(Editor's note: The research program is summarized in the following excerpt from Mr. Cunningham's reply. Each of the major research projects is described below under separate titles. The title above was supplied by the editor.)

The tree research at our laboratories is primarily directed at solving problems associated with trees growing in field shelterbelts and farmstead windbreaks. However, the results of our research are often applied to urban tree problems and windbreaks.

Genetic improvement of trees and shrubs for the Northern Great Plains

Research objectives:

a. Tree and shrub cultivars genetically improved for hardiness, pest and herbicide tolerance, faster growth rate, better crown form, and reduced crop competition.

b. Efficient techniques for propagating, establishing, and managing genetically improved trees and shrubs in seed orchards and clonal stool beds.

2.11 Breeding

Priority species:

a. Elms--Siberian, Japanese, slippery

b. Poplar--cottonwood, hybrid poplars

c. Bur oak

d. Junipers--Rocky Mtn., eastern redcedar

e. Pines--lodgepole, ponderosa

f. Hackberry and honey locust

Current research programs:

a. Establishment of a broad-based gene pool of Ulmus (elm) genotypes and establishment in a breeding arboretum.

b. Assemble a diverse gene pool of Populus clones into clonal archives.

(2.11/2.12)

Disease resistant trees and shrubs for shelterbelts in the Northern Great Plains

The overall objectives involve: (1) identification of the causal agent's pathogens involved in the diseases of windbreak species; (2) development of selection criteria for disease resistance; (3) provision of information on management systems that will enhance disease control; and (4) contribution to the development of superior cultivars for future plantings. (2.32)

Water relations and physiological stress effects on growth and development of windbreak trees

Research emphasis will be on the effects of water deficits and air temperature on tree growth and development, and the effects of stress factors on tree susceptibility to diseases and phenoxy herbicides. Also, water requirements, rooting patterns, and the level of competition of species planted in windbreaks needs to be determined to provide for better selection of species for specific soils, growing conditions, and cropping systems. (2.23/2.4)

2.11 Breeding

RESEARCH PROGRAM: SHADE TREE LABORATORIES, UNIVERSITY OF MASSACHUSETTS (2.11/2.23/2.32/2.4)

HOLMES, Francis W.
Director of Shade Tree Laboratories
College of Food and Natural Resources
University of Massachusetts
Amherst, Massachusetts 01002

(413) 545-2402

(Editor's note: Following are excerpts from Mr. Holmes's reply. The above title was supplied by the editor)

Allelopathy study:

We are beginning a controlled study of allelopathy (toxic effects of trees of one species upon trees of another species, usually through chemical exudates), now especially well known from walnuts and sugar maple. (2.4)

Dutch elm disease research:

Elm bark beetle attraction and trapping with pheromones.

Dr. G. N. Lanier, SUNY College of Environmental Science and Forestry, used our Dutch elm disease data--collected in Massachusetts, town-by-town for many years--in this project. The project included analysis of Dr. Lanier's research results on disease control--conducted at Phillips Academy, Andover, Massachusetts--within the context of losses over the years to Dutch elm disease in the town of Andover and Massachusetts as a whole.

Disease transfer.

Arrangements were made (in cooperation with the Town of Amherst) to try to transfer the Dutch elm disease fungus from a bark-beetle infested log of an elm that had died several months earlier, to each of approximately 300 young elms (1" to 3" dbh) in the Hadley research nursery. (2.32)

Disease control research.

Of eight large elms injected with benomyl phosphate in June and July, 1975, on the University of Massachusetts campus (as soon as natural infections were found), six have now died, and two survived the 1975-76-77 seasons without any wilt. By now the treatment may be considered to have worn off. Last minute note: In the 1978 season, foliage on both of these remaining trees wilted. (2.32)

To compare the injection methods of Knodo (through ends of severed roots) with that of the Elm Research Institute (through holes drilled into the base of the trunk), arrangements were made to inject elm trees to see whether distribution of the trunk differs. (2.32)

Comparison of aggressive capabilities of fungus cultures.

Our 'Groeneveld' and 'Crommelin' nursery elms, planted in the fall of 1976, suffered winter injury in the winter of 1977-1978; however, all but two of the trees remain alive. In this plantation we had expected to be able to distinguish between lower and higher aggressive capability of cultures of the Dutch elm disease fungus, but the trees are insufficiently established to give reliable results as yet. (2.32)

Resistant species breeding.

Only one resistant tree formed seeds this year, but others are expected to form seed next year. Earlier crosses (NY-R18-2) have not shown any inheritability of resistance. Seeds were grown in the greenhouse nevertheless. (2.11)

Verticillium wilt disease research:

A study of Verticillium wilt disease tolerance of stressed maples was started by innoculating selected trees of sugar, silver, red, and Norway maple. Some of these trees were suffering already from artificially induced drought, or smothering by the plastic equivalent of pavement, or fill, or cut roots, in respective plots. They were put in contrast with three groups of control maples: (1) with Verticillium but no stress, (2) with stress but no Verticillium, and (3) with neither stress nor Verticillium. The first season no symptoms of maple wilt were detected, so the trees are scheduled for reinnoculation with newly isolated cultures of the fungus Verticillium sp. (2.32)

A proposal for a grant to continue earlier studies of comparative levels of salt plus Verticillium, for tolerance and susceptibility in maples planted in a parking lot, is being rewritten for the new Pathology Section of the Consortium for Environmental Forestry Studies (2.32). We are in the initial stages of studying electrical resistance of the transpiration stream of ring-porous trees like elm and oak, also maples, to see if findings will help to control wilt diseases. (2.4)

2.11 Breeding

Painting of trees:

We still have seen no harm to the 10-year-old silver and sugar maples whose trunks we painted several years ago with white latex house paint as a possible equivalent of whitewash. (Oil-based house paints are known to kill trees.) The effect is not likely to wear off quickly through weathering after the need for cooling (after transplanting) no longer exists. However, we have an oral report of tree injury in a comparative experiment in Michigan. (2.23)

Comparison continues of the single painting of wounds, versus no painting, versus painting renewed every 3 months, versus painting renewed every 3 months with benomyl added to wound paint. It is too early (4 years) for these trees to be sacrificed to see the eventual extent of wood decay invasion. (2.23)

Girdling injury:

Thirteen years of artificial girdling (by bolting angle irons) have not yet caused visible injury to foliage and twigs in sugar, silver, red, and Norway maples in our Hadley shade tree research nursery, although the bases of the trunks are greatly distorted on the parallel, constricted sides. A few trees are now so large that they will soon be wholly girdled and die. This result has not been published. (2.32)

Production of Ailanthus altissima seedlings for research use:

Seeds of Ailanthus altissima (Tree-of-Heaven) were stratified in sand under refrigeration with and without fungicide treatment. Others were planted directly in greenhouse flats with and without fungicide treatment, and others were planted directly in the nursery in field soil, with and without fungicide treatment. Stratification proved needless because all seed lots gave abundant seedlings. These trees will serve for many future experiments to determine the usefulness of Tree-of-Heaven in certain locations. (2.11)

Publications from Shade Tree Laboratories (Amherst):

Holmes, F. W. 1978. Annual report--Dutch elm disease. Univ. Mass. Shade Tree Labs., 3 p.

Holmes, F. W. 1978. Massachusetts tree warden town histories . Univ. Mass. Shade Tree Labs. Mass. Tree Wardens' & For. Assoc. Bark 6 (1):6.

Holmes, F. W. 1978. Summary of conference Mass. For. and Park Assoc. 32nd Annu. Conf. on Dutch Elm Disease Proc. 32:13-15.

Holmes, F. W. 1978. Shade trees--the friends of the poor and the city-dweller. The Dawes Arbor. Newsl. 11(2):6 Neward, Ohio.

Holmes, F. W. 1978. Canker diseases of trees and shrubs. J. Arboric. 4(2):47-48.

Holmes, F. W. 1978. Tree wardens battered, bloodied, but unbowed by blizzard of '78--meet during the "Storm of the Century". Mass. Tree Wardens' & For. Assoc. Bark.

Holmes, F. W. 1978. Social and economic consequences of the Extension Service--shade tree program. 4 p. Coop. Ext.

Holmes, F. W. 1978. Nontransmission of Ceratocystis ulmi from Dutch elm diseased to healthy American elms by chainsaw. Am. Phytopathol. Soc. Proc. 1977. Vol. 4. 85 p.

Holmes, F. W. and T. A. Tattar. 1978. Tree disease research in Massachusetts. Submitted to 19th Northeastern Forest Pathology Workshop. 1.

Holmes, F. W. 1978. Review of: "The comparative effectiveness of pruning versus pruning plus injection of trunk and/or limb for therapy of Dutch elm disease in American elms", by G. F. Gregory and J. R. Allison, 13 p.

Holmes, F. W. 1978. Before you buy a tree-shaded home...Mass. Coop. Ext. Serv. Publ. 2 p.

Holmes, F. W. 1978. Street tree inventories. Report to Mr. C. S Hood, Chief of Mass. Bur. Insect Pest Control. Boston. 3 p.

Holmes, F. W. 1978. How to choose an arborist (tree expert). Univ. Mass. Shade Tree Lab. 2 p. rev.

SOME RESEARCH TOPICS: CARY ARBORETUM (2.11/2.12/2.32)

KARNOSKY, Dr. David F.
Forest Geneticist
Cary Arboretum
Box AB
Millbrook, New York 12545

(Editor's note: Dr. Karnosky has sent the titles of the following research topics. The above title was supplied by the editor.)

2.11 Breeding

1. Improving air pollution tolerance of urban trees. (2.11)
2. Progeny testing air pollution tolerance in Acer and Fraxinus. (2.12)
3. Developing disease resistant elms. (2.11)
4. Studying the London plane tree-decline problem in New York City. (2.32)
5. Cytogenetics of trees. (2.11)

Citations from publications produced from this project:

1. Karnosky, D. F. 1978. Testing the air pollution tolerances of shade tree cultivars. J. Arboric. 4(5):107-110.
2. Karnosky, D. F., and Daniel B. Houston. 1979. Genetics of air pollution tolerance of trees in northeastern United States. In 26th Northeast. For. Tree Improve. Conf. Proc. 1979:161-178.
3. Karnosky, D. F. Selection and testing programs for developing air pollution tolerant trees for urban areas. IUFRO Air Pollution Meeting. 1978. Ljubljana, Yugoslavia. (In press)
4. Karnosky, D. F. 1978. The plight of New York's stately elms. NAHO 11(2):2-5
5. Karnosky, D. F. 1977. A simple, rapid giemsa staining technique for routine study of tree chromosomes. Can. J. For. Res. 7:435-440.
6. Karnosky, D. F. 1977. Evidence for genetic control of response to sulfur dioxide and ozone in Populus tremuloides. Can. J. For. Res. 7:437-440

BREEDING AND TESTS PITCH AND LOBLOLLY PINE HYBRIDS (AND MASS PRODUCING DESIRABLE ONES) (2.11)

LITTLE, Silas
USDA Forest Service
Northeastern Forest Experiment Station
The Pennsylvania State University
University Park, Pennsylvania 16802

2.11 Breeding

a. An orchard of 32 pitch pine clones from Virginia, West Virginia north to upstate New York and Maine, and 33 loblolly clones from Maryland and Delaware was established in New Lisbon, New Jersey mostly in 1964.

b. Controlled crosses between some of the individual clones were made in 1974-78 (also through pollen from other clones that were shipped in).

c. Test plantings (29) were made in 9 states in 1971-77--11 to 103 hybrid stock, plus check stocks in a planting.

d. Certain hybrids have very good growth and form, being 50 to 100% taller than certain check stocks 3 to 5 years after planting, and so far some hybrids have proved winter-hardy in all plantings (Saratoga County, New York, Merrimack County, New Hampshire).

e. Because of climatic effects, different hybrids are best in different areas.

f. Because of demands for stock for mass plantings (1) pollen has been applied with a mistblower (without bagger), and University of New Hampshire is estimating through isoenzyme studies the hybrid proportion of resulting seeds; (2) states of Maryland and New Jersey are starting F, orchards for wind pollination and for determining the value of resulting offspring.

REESTABLISHING NATIVE VEGETATION IN OVERUSED RECREATIONAL AREAS (2.11)

LITTLE, Silas
USDA Forest Service
Northeastern Forest Experiment Station
The Pennsylvania State University
University Park, Pennsylvania 16802

Starting and completion dates: 1978-1979

Treatments tried in two blocks in each of four Maryland park areas were digging, mulching and fencing, plus planting wild shrubs, wild herbaceous plants, and barrier plants such as catbrier.

LONG TERM (ABOUT 40 YEARS) CHANGES IN STAND COMPOSITION IN THE NEW JERSEY PINE BARRENS FROM PRESCRIBED BURNING (2.11)

2.11 Breeding

LITTLE, Silas
USDA Forest Service
Northeastern Forest Experiment Station
The Pennsylvania State University
University Park, Pennsylvania 16802

Starting and completion dates: 1978-1979

Changes as a result of 0 to 15 prescribed burns, seed-tree cuttings and wildlife in the resulting sapling stands of 2 study areas (one of thirty-two 2.5-acre plots; one of twenty-eight 0.5-acre plots).

EVALUATION OF PLANTS FOR GROWTH, PERFORMANCE, AND LANDSCAPE CHARACTERISTICS (2.11/2.12)

MOWER, Robert G.
Cornell University
Ithaca, New York 14853

Sponsored by: Hatch Project 141414

Evaluate variants of woody plants to determine their suitability for landscape planting under New York State conditions.

Determine the kinds of trees best suited for use along streets and highways by observing growth and performance characteristics.

CYTOGENETICS, BREEDING, AND EVALUATION OF LANDSCAPE TREES (2.11/2.12/2.4)

SANTAMOUR, Frank
U.S. National Arboretum
Washington, D. C. 20002

(202) 399-5400

Sponsored by: U.S. Department of Agriculture

Starting and completion dates: July 31, 1967 to termination

Our work at the U.S. National Arboretum is really not a research project but a dedicated and continuing program of research to develop better trees for urban planting. Pest resistance has been especially important in the past.

New proposed research will deal with the genetics and physiology of wounds and graft incompatibility in landscape trees.

2.11 Breeding

Citations of publications produced from this project:

(Editor's note: 1977-78 publications only are included here.)

Santamour, Frank S., Jr. 1977. Flavonoid distribution in Gleditsia. J. Arboric. 3:14-18.

Santamour, Frank S., Jr. and Frederick G. Meyer. 1977. Clarifying monarch birch's origins and characteristics. Am. Nurseryman 145(12):7, 88-94.

Santamour, Frank S., Jr. 1977. The selection and breeding of pest-resistant landscape trees. J. Arboric. 3:146-152.

Santamour, Frank S., Jr. 1977. Breeding better urban trees--Problems, practices, and potential. South. For. Tree Improv. Conf. Proc. 14:2-12.

Santamour, Frank S., Jr. and Duane F. Zinkel. 1977. Resin acids, resin crystallization, and weeviling in Balkan x eastern white pine hybrids. Northeast. For. Tree Improv. Conf. Proc. 25:164-175.

Santamour, Frank S., Jr. 1977. Dutch elm disease control--1977: A symposium summary. In The Current State of the Art of Dutch Elm Disease Control, F. S. Santamour, Jr. and Robert Felix (Eds.) Natl. Arborist Assoc. Symp. No. 1, p. 108-118.

Santamour, Frank S., Jr. 1978. Where are the sweet honeylocusts today? Am. Assoc. Bot. Gard. Arbor. Bull. 12(1):24-28.

Santamour, Frank S., Jr. 1978. Seed orchards provide seed for uniform widely adaptable seedlings. Am. Nurseryman 147(8):13, 67-71.

Demuth, Polly and Frank S. Santamour, Jr. 1978. Carotenoid flower pigments in Liriodendron and Magnolia. Bull. Torrey Bot. Club 105: 65-66.

Santamour, Frank S., Jr. 1978. Susceptibility of honeylocust (Gleditsia) species to mimosa webworm. Metrop. Tree Improv. Alliance (METRIA) Proc. 1:49-56.

Santamour, Frank S., Jr. 1978. Interspecific hybridization in Carpinus. Metrop. Tree Improv. Alliance (METRIA) Proc. 1:73-79.

Santamour, Frank S., Jr. 1978. Carotenoid flower pigments in Rhododendron. HortScience 13:461-462.

PROVENANCE TESTING--GENE SOURCE FOR URBAN TREE IMPROVEMENT (2.11/2.12)

STEINER, Kim C.
The Pennsylvania State University
University Park, Pennsylvania 16802

Sponsored by: The Consortium for Environmental Forestry Studies

Completion date: June 1979

Provenance and progeny collections for green ash, sweetgum, and pin oak have been assembled for the purpose of studying genetic variation in traits important for the survival of trees in densely populated areas.

USE OF AILANTHUS ALTISSIMA AS A LOW-MAINTENANCE SPECIES FOR POOR URBAN PLANTING SITES (2.12/2.21)

ANDERSON, Linda M. (USFS) and MIXON, John (Georgia Forestry Commission)
Forestry Sciences Laboratory
Carlton Street
Athens, Georgia 30602

(404) 546-2451

Sponsored by: USDA Forest Service

Starting and completion dates: November 1, 1978--November 1, 1980

Determination of growth and survival potential of *Ailanthus altissima* ("tree of heaven") on low quality urban sites, and determination of aesthetic contribution of this species relative to other possible species choices (for example, sumacs, princess tree) suitable for the same locations.

BENEFITS OF MYCORRHIZAL INNOCULATION AND SATURATION PLANTING OF TREES IN POOR URBAN PLANTING SITES (2.12)

CORDELL, H. K. (USFS) and MIXON, John (Georgia Forestry Commission)
Forestry Sciences Laboratory
Carlton Street
Athens, Georgia 30602

(404) 546-2451

Sponsored by: USDA Forest Service and Georgia Forestry Commission

Starting and completion dates: November 1, 1978--December 31, 1980

Determination of growth and survival rates of selected oak and pine species in adverse urban situations under varying conditions of planting density, mycorrhizal innoculation, and sludge fertilization. Trees will be monitored periodically to detect the extent and severity of vandalism damage.

SELECTION OF PLANT MATERIALS FOR URBAN CONDITIONS (2.12)

HILLIARD, Edmund
559 Buckingham Avenue
Syracuse, New York 13210

(315) 472-4979

Sponsored by: City of Syracuse, Parks and Recreation Department

Starting and completion dates: 1977-1980

Research centered around various conditions that plant materials must tolerate in the city, and best plant materials to tolerate those conditions. End result should provide information for urban ecosystem planning in Syracuse. Emphasis is on communities of plants as used in the urban forest, as opposed to a limited focus on street trees.

GUIDE FOR RECOMMENDED ORNAMENTAL URBAN TREES IN ARIZONA (2.12)

MACBETH, David R.
1624 W. Adams
4th Floor
Phoenix, Arizona 85007

(602) 255-4633

Sponsored by: Forestry Division, Arizona State Land Department

Starting and completion dates: September 1978--February 1979

Research to identify exotic and native trees capable of growing and surviving in the diverse urban environments throughout Arizona. Information on about 100 species including physical, leaf, flower, fruit characteristics for identification; pruning, fertilization, watering requirements; insects and disease susceptibility; faults and remarks.

PRELIMINARY WORK IN SOMATIC CELL HYBRIDIZATION OF AMERICAN ELM (2.12/2.11)

REDENBAUGH, M. K. (WESTFALL, R. D., SUNY CESF: KARNOSKY, D. F., Cary Arboretum)
SUNY College of Environmental Science and Forestry
Syracuse, New York 13210

Sponsored by: U.S. Park Service and the Rockefeller Institute (submitted for funding)

Completion date: 1980

Sexual, interspecific hybridization between American elm and other elm species has not been successful. This has prevented the incorporation of the Siberian and the Chinese elm's Dutch elm disease resistance with the American elm's aesthetic qualities. Plant tissue culture methods involving another culture, protoplast production, and somatic cell hybridization are proposed as techniques to overcome the crossability barriers between American elm and other elm species.

GENETIC "FINGERPRINTING" IN URBAN TREE VARIETIES (2.12/2.4)

SPRY, T. (WESTFALL, R. D.)
SUNY College of Environmental Science and Forestry
Syracuse, New York 13210

Sponsored by: The Consortium for Environmental Forestry Studies

Completion date: 1979

All breeding procedures have been developed to enable tree breeders to select and propagate genetically improved varieties. Choice of proper breeding methods depends primarily on the extent and distribution of genetic and environmental variability for desired traits in the population being used for selection. But in working with urban tree populations, breeders are faced with diverse environments, ancestries of unknown origin, and artificial population structures. The traditional method used to determine genetic differences among individual trees under difficult conditions has been to plant representatives of those trees, either as cuttings or as seedlings, in common environments. However, space and time requirements for such tests can be substantial. Thus, procedures which enable breeders to make genetic distinctions among standing urban trees would be desirable.

Proteins, being one step removed from the genetic code, can be used as a tool in making such genetic distinctions. This technique has been used to study natural populations of tree species. Thus, there is no reason that the technique could not be applied to the task of identifying cultivars and families in urban trees.

It is the objective of this study to develop analytic procedures needed to define genetic differences in selected populations of urban sugar and Norway maple families. Such procedures will be useful as aids in breeding tree varieties which are well-adapted to urban environments, a goal of the Pinchot Consortium.

EARLY TESTING FOR INSECT AND DISEASE RESISTANCE IN URBAN TREES (2.12/2.31/2.32)

VALENTINE, F. A.
SUNY College of Environmental Science and Forestry
Syracuse, New York 13210

(315) 473-8812

Sponsored by: The Consortium for Environmental Forestry Studies

Starting and completion dates: May 1, 1978-April 30, 1980

Field, nursery, and greenhouse tests are being used to characterize the variability in resistance to *Verticillium alboatrum* and *Empousca pobal*, the potato leafhopper, in the urban tree population of Norway and sugar maple. Relationships among maternal half-siblings will be used to estimate the heritability of *Verticillium* resistance in these populations, and techniques for test resistance to the potato leafhopper are being developed.

ESTABLISHMENT OF URBAN TREE PROGENY TEST POPULATIONS--A BASE FOR BREEDING NORWAY AND SUGAR MAPLE (2.12/2.11)

VALENTINE, F. A.
SUNY College of Environmental Science and Forestry
Syracuse, New York 13210

(315) 473-8812

Sponsored by: The Consortium for Environmental Forestry Studies

Starting and completion dates: May 1977-April 1979

Maternal half-sibling families have been established from open-pollinated seed collected from random samples of Norway and sugar maple street trees in Rochester and Syracuse, New York, and from selected "superior" trees solicited from cities in the Northeast. Germination, growth rates, and survival are being monitored for the first 2 years in the nursery beds. Greenhouse studies have been conducted to develop innoculating procedures for *Verticillium alboatrum* and criteria for quantitative assessment of rate and extent of disease development in young seedlings.

DESCRIPTIONS AND ANALYSES OF BRANCHING HABITS OF SELECTED SHADE TREES SPECIES AND CULTIVARS (2.12)

VRECENAK, Arthur (MOWER, Robert G.)
Cornell University
Ithaca, New York 14853

Precision is lacking in most descriptions of branching characteristics of shade trees. Because proper selection may depend on branching features, studies are underway to determine the feasibility and possible approach to adding precision in describing this aspect of plant growth. Efforts are being made to categorize branching at various levels of development in order to provide a better basis for utilizing branching characteristics in the plant selection process.

URBAN FORESTRY RESEARCH (2.12/2.13/2.23/3.11)

WAGAR, J. Alan
USDA Forest Service
Pacific Southwest Forest and Range Experiment Station
Berkeley, California

As of October 1, 1977, the Urban Forestry Research Project was formally established and will address four problems: (1) knowledge for selecting, establishing, and maintaining trees and shrubs to achieve specific environmental goals in semi-arid urban environments is inadequate; (2) available principles and procedures are inadequate for planning and designing urban forests and for protecting these areas, as well as people and their structures and related resources; (3) no existing system provides fast, efficient, and economical gathering, analysis, storage, and distribution of technical urban forestry information (this problem was inactive during 1979); and (4) knowledge of people's attitudes toward urban forests is inadequate, as are methods for gaining and utilizing public involvement in establishing and caring for urban forests, and methods for using urban forests to increase people's environmental understanding.

WINTER PROTECTION OF CONTAINER-GROWN ORNAMENTAL PLANTS (2.13/2.23)

STEPONKUS, Peter L. and GOOD, George L.
Cornell University
Ithaca, New York 14853

Sponsored by: Cornell University Agricultural Experiment Station

Completion date: 1980

Experiments are proposed to (1) characterize the thermal environments in overwintering structures, (2) determine the influence of the shoot and its environmental root hardiness, (3) determine if the root regeneration potential is a factor limiting plant survival, (4) assess factors contributing to winter dessication of broad leaved evergreens in overwintering structures, and (5) utilize tissue culture for selection of hardiness at the cellular level.

MANAGEMENT OF LANDSCAPE MAINTENANCE (2.23)

HARRIS, Richard W., and MILLS, Allan
Environmental Horticulture
University of California
Davis, California 95616

(916) 752-0130

Sponsored by: Hatch Act--California Agriculture Experiment Station

Starting and completion dates: January 1977 to June 1981

Twenty-five California city, county, and state agencies that have modified policies in the management of landscape maintenance were studied to learn approaches being used and the results. Common management procedures included:

1. involvement of employees in developing programs;

2. inventorying of resources to be maintained;

3. listing and describing how tasks are to be done;

4. determining time standards for tasks described;

5. setting of frequencies with which tasks are to be done;

6. scheduling tasks in order to use personnel and equipment to advantage;

7. implementing programs; and

8. monitoring work and schedules and adjusting as needed.

All steps were involved in every management undertaking--either through design or default. The most important steps to increase productivity are involving employees and scheduling their work.

Citations of publications produced from this project:

Harris, Richard W. 1977. A management approach to tree maintenance. J. Arboric. 3(6):101-107.

Harris, Richard W. 1977. A management approach to park maintenance. Parks and Recreation 12(12):32-34.

TRUNK DEVELOPMENT OF LANDSCAPE TREES (2.23)

HARRIS, Richard W. and LEISER, Andrew T.
Environmental Horticulture
University of California
Davis, California 95626

(916) 752-0130

Sponsored by: California Agriculture Experiment Station

Starting and completion dates: January 1973-December 1979

A young tree alone, with its top free to move, usually becomes a strong tree better able to withstand the elements. In comparison to a rigidly staked tree an unstaked tree will have these characteristics:

1. Greater caliper at the trunk's base.

2. Less growth in height.

3. Greater trunk taper.

4. Less wind resistance when compared trees are of equal height because the top is free to bend.

5. Subject to less stress per unit of trunk cross-sectional area at the support point.

6. More uniform xylem tissue (wood) for supporting itself upright.

7. No rubbing or girdling injuries.

8. A larger root system.

Citations of publications produced from this project:

Harris, R. W., and W. D. Hamilton. 1969. Staking and pruning young _Myoporum laetum_ trees. J. Am. Soc. Hortic. Sci. 94:359-361.

Harris, R. W., W. D. Hamilton, W. B. Davis, and A. T. Leiser. 1978. Pruning landscape trees. U.S. Agric. Ext. Leafl. 2574.

Leiser, A. T., R. W. Harris, D. Long, W. Stice, R. Maire, and P. L. Neel. 1972. Influence of staking and pruning on container-grown nursery trees. J. Am. Soc. Hortic. Sci.

Leiser, A. T., and J. D. Kemper. 1968. A theoretical analysis of a critical height of staking landscape trees. Am. Soc. Hortic. Sci. Proc. 92:713-720.

Leiser, A. T., and J. D. Kemper. 1972. Analysis of stress distribution in the sapling tree trunk. J. Am. Soc. Hortic. Sci.

Neel, P. L. 1967. Factors influencing trunk development of landscape trees. Int. Shade Tree Conf. Proc. 43:293-303.

MONMOUTH COUNTY SHADE TREE COMMISSION 1978 SUPERINTENDENT'S ANNUAL REPORT (2.23/2.31/2.32/3.4/3.41)

SHAW, David C.
Superintendent
Shade Tree Commission
Holmdel Arboretum
Hall of Records Annex
20 Court Street
Freehold, New Jersey 07728

(201) 431-7910

(Editor's note: The following are excerpts from the report.) The above title was supplied by the editor.)

We have systematically expanded our field operation that includes: the gypsy moth program, roadside shade tree plantings, landscaping of county vocational schools and other buildings, continued progress in the Holmdel arboretum, our seashore test garden areas, our shade tree and shrub nursery, continuing municipal shade tree care and maintenance, and tree care on county roads and right of ways.

2.23 Care and Maintenance

Tree injection test program

This was the eighth full year that we have been working on the experimental gypsy moth tree injection program with the Guardian Tree Expert Company from Maryland and Dr. Louis Vasary of Rutgers University. The chemicals used were Meta-Systox R and Bidrin, and the controls were excellent. There seems to be a little problem of the wounds not healing properly on some of the trees, but most trees healed well. This experimental program will be continued for 2 more years. (2.31)

Street tree survey

This year we studied our street tree survey of all county roads. The gypsy moth survey team gathered all the information needed. This has never been done in Monmouth County before, and the information is long overdue. This survey gives us permanent data on types of trees, size, condition, etc. Eventually we want to give a monetary value to our shade tree investment and do a cost analysis per tree on county roads. We want to know what types of trees are growing within our jurisdiction, percentages of each, and the total number. Our pilot is responsible for the crew doing the street-tree survey and keeping it up to date. (3.4/3.41)

Tree problems--Monmouth County

These past several years, Don Mohr, our county agricultural agent, and Mr. Shaw made a study of many tree problems in Monmouth County and have found that the biggest factor of dying trees is girdling roots. Extensive research throughout the years determined that trees planted 10 to 15 years ago were planted too deep and, in some instances, with twisted roots. These roots seem to grow back and around the trunk of the tree and cut off the sap flow up the tree.

Container-grown stock seems to have the same effect and presented the same problems of girdling roots as the trees became older. More inspections and data will be taken in 1979. Because of two severe winters, many dogwoods suffered from winter damage and twig blight. Even more twig damage will probably become evident in 1979. (2.23/2.32)

FOLIAR NUTRITION OF ECONOMIC PLANTS (2.23)

TUKEY, H. B., Jr.
Cornell University
Ithaca, New York 14853

Sponsored by: Horticultural Research Institute of American Association of Nurserymen

2.25 Soils/2.3 Protection/2.31 Insects

Starting and completion dates: 1978-82

Study the use of foliar nutrition: (1) to meet the nutritional needs of economic plants, (2) to reduce nutrient runoff and ground water pollution, and (3) to provide nutrients to plants in both agricultural and nonagricultural situations.

WOOD CHIP MULCHING FOR URBAN TREE PLANTING (2.25/2.23)

HAM, Donald and DUNN, B. Allen
College of Forest and Recreation resources
Clemson University
Clemson, South Carolina 29631

(803) 656-2478

Sponsored by: USDA Forest Service

Starting and completion dates: September 1, 1978-August 31. 1980

Evaluate the effectiveness and costs of wood chip mulching for improving the structure, composition, fertility, and microorganism content of urban soils for tree growth.

STRESS DETECTION IN URBAN TREES (2.3)

MANION, P., and others
SUNY College of Environmental Science and Forestry
Syracuse, New York 13210

Study remote sensing methodology including microdensitometric and digital scan techniques. Evaluate multivariate correlation of microdensitometric measurements and ratioing of spectral bands with stress symptoms. Evaluate objective and subjective ground assessment techniques. Characterize obligate internal pathogen effects on stress symptoms over time.

AN ANALYSIS OF THE MAJOR INSECT AND DISEASE PROBLEMS OF URBAN FORESTRY IN THE SOUTH (2.31/2.32)

BERISFORD, Yvette and HUNTER, Preston
Entomology Department
University of Georgia
Athens, Georgia 30602

(404) 542-7888

Sponsored by: USDA Forest Service

Starting and completion dates: November 1, 1978-July 13, 1978

Identify, describe, and set priorities for the major insect and disease problems relative to current research needs.

For the highest priority studies, develop detailed study plans showing objectives, problem description, expected results, detailed procedures, etc.

Construct a permanent photographic slide reference file of descriptive information on insect and disease problems.

LIFE CYCLE OF THE SMALLER EUROPEAN ELM BARK BEETLE IN GEORGIA (2.31/2.32)

BERISFORD, Wayne
Department of Entomology
Bio-Sciences Bldg.
University of Georgia
Athens, Georgia 30602

(404) 542-7888

Sponsored by: USDA Forest Service

Starting and completion dates: June 1, 1978-May 31, 1980

Determine the number of annual generations of *Scolytus multistriatus* in Georgia. Determine and compare rates of brood development in the different geographical areas. Determine if *S. multistriatus* brood development or survival is affected by different elm hosts: American elm (*Ulmus americana*), winged elm (*U. alata*), and slippery elm (*U. pulva*).

INSECTS AFFECTING WALNUT (2.31)

JOHNSON, W. T.
Department of Entomology
Cornell University
Ithaca, New York 14853

(607) 256-4426

2.31 Insects

Sponsored by: State University of New York

Walnuts of several species may be used for shade and home horticulture. Pest control and sometimes the pests are different when encountered under urban conditions. As the opportunity arises, studies are conducted to deal with insects associated with Juglans species. This is an open-ended project.

Citations of publications from this project:

MacDaniels, L. H., W. T. Johnson, and J. E. Braun. 1975. The black walnut bunch disease syndrome. 60th Annu. Rep. North. Nut Growers Assoc. p. 71-87.

MICROBIAL PESTICIDES FOR ORNAMENTAL PLANTS (2.31)

JOHNSON, W. T.
Department of Entomology
Cornell University
Ithaca, New York 14853

(607) 256-4426

Microbial pesticides are highly desirable, especially in urban environments. We expect to utilize bacteria, viruses, and fungi known to be pathogenic to certain insects and apply them with traditional and new technology equipment.

Citations of publications from this project:

Johnson, W. T., J. C. Cunningham, and W. J. Kaupp. 1977. Insect virus application with a cold fog generator. Can. For. Serv. Bi-mon. Res. Notes 34(4):25-26.

CONTROL OF INSECTS AND MITE PESTS OF WOODY ORNAMENTAL PLANTS, SHADE TREES, AND CHRISTMAS TREES (2.31)

JOHNSON, W. T., and ZEPP, D. B.
Department of Entomology
Cornell University
Ithaca, New York 14853

(607) 256-4426

Studies under this project include insect and mite biology, control, and observations relative to plant tolerance and resistance to insects. Much of this work is utilized in updating the New York State (Cornell) recommendations for the control of insects affecting trees and shrubs.

MICROBIAL PESTICIDES--THEIR PRACTICAL APPLICATION TO CONTROL INSECTS AFFECTING TREES AND SHRUBS (2.31)

JOHNSON, W. T.
Department of Entomology
Cornell University
Ithaca, New York 14853

Sponsored by: Cornell University, College of Agriculture and Life Sciences

Field tests were conducted during the summer of 1977 using Bacillus ingiensis combined with sub-lethal doses of chemical insecticides to control forest tent caterpillar, spruce budworm, and fall webworm. This work was unique because of the method of application, using a Leco ULV Cold Fog Generator. The treatments were highly successful for controlling forest tent caterpillar, Malacosoma disstria.

Also a nuclear polyhedrosis virus distributed through a cold fogger was successful in controlling the red-headed pine sawfly (Neodiprion leocontei). The results were sufficiently encouraging to warrant continued work.

MANAGEMENT OF ELM BARK BEETLES AND DUTCH ELM DISEASE WITH BEHAVIOR-MODIFYING CHEMICALS (2.31/2.4)

LANIER, Gerald, O'CALLAGHAN, Dealga, and GALLAGHER, Ellen
Department of Environmental and Forest Biology
SUNY College of Environmental Science and Forestry
Syracuse, New York 13210

(315) 473-8751

Sponsored by: Freshwater Biology Foundation, Minneapolis, Minnesota and USDA Forest Service

Starting and completion dates: Ongoing to 1981

Three years of mass-trapping European elm bark beetles on pheromone sticky traps has coincided with decline in Dutch elm disease rates in all test areas. Commercial development of this technique is being pursued.

Pheromone baits are also being used experimentally to lure beetles to diseased elms that have been killed by injection with an herbicide. The 1st year (1978) of research with this technique showed that in-flight beetles attack these trees in large numbers, but brood production is 84-100% reduced. This technique shows potential for producing healthy elms by managing beetle populations and diseased elms at low cost.

Citations of publications produced from this project:

Lanier, G. N., R. M. Silverstein, and J. W. Peacock. 1976. Attractant pheromones of the European elm bark beetle (Scolytus multistriatus): Isolation, identification, synthesis and utilization studies. In: Perspectives in forest entomology. J. E. Anderson and H. K. Kaya, eds., Academic Press, NY, pp. 149-175.

Lanier, G. N. 1978. Behavior-modifying chemicals as a basis for managing bark beetles of urban importance. In Perspectives in urban entomology. G. Frankie and C. Koehler, eds., Academic Press, NY, pp. 295-310.

BIOLOGY AND CONTROL OF INSECT PESTS OF WOODY ORNAMENTAL AND CHRISTMAS TREES (2.31)

ZEPP, Donald B.
Cornell University
Ithaca, New York 14853

Sponsored by: Cornell University, College of Agriculture and Life Sciences

A flexible program designed to investigate life cycles and all available control techniques for insect and mite pests of woody ornamentals and Christmas trees. Current major activity involves root-feeding weevils and sessiid borers in lilac and dogwood. Insecticide screenings are performed as required to meet the nursery and Christmas tree industry's need.

ACTIVITY OF SYSTEMIC FUNGICIDES ON THE SYCAMORE CANKER STAIN FUNGUS (2.32)

McCRACKEN, F. I.
Southern Forest Experiment Station
P.O. Box 227
Stoneville, Mississippi 38776

(601) 686-7218

Sponsored by: USDA Forest Service

Completion date: June 1979

Seven systemic fungicides were tested for their potential control of Ceratocystis fimbriata f. platani. Of the materials tested, Lignasin and Arboteck show the greatest activity on the fungus.

Citation of publication produced from this project:

Van, S. R. and F. I. McCracken. 1979. Activity of systemic fungicides on the sycamore canker stain fungus. J. Miss. Acad. Sci. (Suppl.) p. 10.

THE CAUSE OF DIEBACK OF SOUTHERN MAGNOLIA (2.32)

McCRACKEN, F. I.
Southern Forest Experiment Station
P.O. Box 227
Stoneville, Mississippi 38776

(601) 686-7218

Sponsored by: USDA Forest Service

Starting and completion dates: 1978-1980

Pathogenicity of magnolia fungus associated with dieback and mortality are being determined.

THE EFFECTS OF SOIL COMPACTION AND TREE ROOT EXCISION ON TREE VIGOR AND GROWTH (2.35)

MADER, Donald and WEEKS, David
Department of Forestry and Wildlife Management
University of Massachusetts
Amherst, Massachusetts 01003

(413) 545-2758

Sponsored by: Consortium for Environmental Forestry Studies

Starting and completion dates: April 29, 1977-October 29, 1979

Information is lacking on the effects of different kinds of site development practices on the health, survival, and vigor of trees in housing developments in wooded areas. The survival and continued vigor of residual trees is of great importance for their aesthetic, microclimate, and other amenity values, to avoid the large cost of removal and replacement, and to avoid the long-term period of waiting for maturity of replacemnt trees.

The objectives of the proposed research are to examine in controlled field tests the impacts on trees in housing developments, of soil disturbance, girdling, and root removal, and to determine their effects on survival, vigor, and growth. Relocated single tree plots will be used to test levels and combinations of soil disturbance, girdling, and root removal in respect to the survival, vigor rating, diameter growth, and height growth of oak and/or white pine. These studies should complement other studies regarding the survival and growth of urban trees as influenced by genetics and air pollution.

THE PHYSIOLOGICAL IMPACT OF FUMIGATING CONIFERS WITH OZONE AND SULFUR DIOXIDE (2.36)

LASSOIE, JAMES P.
106 Fernow Hall
Cornell University
Ithaca, New York 14853

(607) 256-2114

Sponsored by: McIntire-Stennis Project 147556

Starting and completion dates: October 1, 1977-September 30, 1980

This study will quantify the physiological effects of ozone and sulfur dioxide on selected conifer species common to New York State. This study is unique since it will simultaneously examine: (1) tree species, (2) physiological activity, (3) concentrations of pollutants below those known to induce visible foliar injury, and (4) pollutants in combination with each other. Pollutant thresholds will be established for each species based on observed reduction in foliar gas exchange rates.

Physiological response to various pollutant fumigations will be assessed from continuous measurements of new assimilation and transpiration rates of seedlings. Gas exchange measurements will be taken using a curvett/gas analysis/environmental control system made available by the Boyce Thompson Institute, Cornell University. Stomatal response will also be examined. Various concentrations of sulfur dioxide and ozone will be used separately and in combination with one another. Optimal light, temperature, and water conditions will be used during the fumigations.

Citations of publications from this project:

Richberger, W. E. and J. P. Lassoie. 1978. Air pollution: Trees can help. Wyo. Cty. Farm and Home News. 64(7):12. (Plus 15 other county Cooperative Extension publications).

Lassoie, J. P. 1978. Urban forestry: The challenge ahead. Greene Cty. Farm and Home News 61(11):14 (Plus 6 other county Cooperative Extension publications).

RESISTANCE OF PIN OAK TO IRON CHLOROSIS (2.36/2.12)

STEINER, Kim C.
The Pennsylvania State University
University Park, Pennsylvania 16802

Sponsored by: The Consortium for Environmental Forestry Studies

Completion date: March 1980

Various strains of the fungus will be grown in combination with different families of pin oak to determine the effects on the growth of the host plant.

EVAPOTRANSPIRATION OF URBAN TREES (2.4)

MILLER, David R.
University of Connecticut
Storrs, Connecticut 06268

Starting and completion dates: 1978-1979

The objective of this proposed research is to study the water use characteristics of mature urban trees by monitoring transpiration (ET) rates in various urban environments. Short term ET rates will be determined from extensive field measurements of sap flux by the Heat Pulse Velocity (HPV) method. Measurements will be made throughout the growing season on trees in a number of urban sites. The sites will be characterized by soil moisture availability and atmospheric moisture demand. The sap flux measurements will be calibrated against diffusion porometer and lysimetric measurements being taken by Pinchot cooperators in Syracuse, New York.

THE STUDY OF THE SOIL-PLANT-ATMOSPHERE CONTINUUM IN URBAN TREES (2.4/1.11)

POTTS, Donald F. and HERRINGTON, L. P.
SUNY College of Environmental Science and Forestry
Syracuse, New York 13210

(315) 473-8642

Sponsored by: The Consortium for Environmental Forestry Studies

Completion date: 1978

The study topic is the soil-plant-atmosphere water continuum of urban honey locust (Gleditsia triacanthos). Trees form an important part of the urban surface and, therefore, play an important role in the determination of urban climate. The primary objective is to obtain information on transpiration from urban trees, which will then allow some evaluation of the evaporative heat-sink information critical to development of meso-scale climatic models.

Lysimetry and detailed observation of meteorological and physiological phenomena are used to test the validity of both simple energy budget evaluations of transpiration and a unique crown model approach which is being developed by Dr. John Norman at the Pennsylvania State University.

STUDY OF CLIENT GROUP, KNOWLEDGE DIFFUSION AND DECISION PROCESSES IN URBAN FORESTRY PLANNING AND MANAGEMENT (3.11)

KOTEN, Donald E., and ROWNTREE, Rowan A.
SUNY College of Environmental Science and Forestry
5 Moon Library
Syracuse, New York 13210

(315) 473-8673

Sponsored by: Pinchot Institute for Conservation Studies, USFS Northeastern Forest Experiment Station, Syracuse, New York

Starting and completion dates: October 1, 1979--September 30, 1980

Over the past several years several conferences have been designed to transfer urban forestry knowledge to practicing professionals and operating managers. While these vehicles of technology transfer have been generally successful for the client groups for which they were designed, they have not had much impact at higher managerial levels in municipal and regional management and planning. One reason for this is that little is known about who makes many of the decisions which affect the urban forest and its management, how these decisions are reached, or what information (and in what form) is desired, or needed, by these decision makers. The purpose of this study is to answer these questions.

Specific objectives include the following: (1) Identify and characterize selected upper management and planning client groups and individuals that have, or can have, an impact on urban forestry research and application; (2) Identify the knowledge diffusion and adoption roles, pathways and processes characteristic of such groups; (3) Develop a limited number of information packages (for example, manuals, background papers, slide-tape programs, monographs) pertinent to the needs of these client groups and evaluate the effectiveness of a sample presentation.

URBANBASE (3.12/3.11)

MAGILL, Arthur W.
USDA Forest Service
Pacific Southwest Forest and Range Experiment Station
Berkeley, California 94701

Starting and completion dates: 1979-1980

Evaluate the feasibility of an interactive computer search and retrieval service, which will contain digests of various types of "gray literature" and scientific and technical publications, processed in plain language, for the use of urban foresters, arborists, extension specialists, horticulturalists, landscape architects, and park managers. The purpose is to provide the practitioners a ready source of the most current information needed to solve the problems that they face while managing parks, greenbelts, and other urban forests.

TRANSLATION AND TRANSFER OF INFORMATION FOR USE IN PLANNING AND MANAGEMENT OF MUNICIPALLY-OWNED URBAN FOREST RESOURCES (3.12/3.34/3.31)

RICHARDS, Norman and STEVENS, Jack
SUNY College of Environmental Science and Forestry
Syracuse, New York 13210

(315) 473-8673

Sponsored by: USDA Forest Service, Northeastern Forest Experiment
Station, Urban Forest Research, Syracuse, New York

Starting and completion dates: October 1978--September 1979

Using the city of Syracuse, New York as a case study area, research will include: (1) further analysis of streetside space and tree resource data from a previous study, with particular attention to its interrelationships with other available information; (2) further examination of the present street-tree management and tree replacement process in Syracuse as it reflects agency objectives and constraints and public values and inputs, in order to identify needs for improved information; (3) development of planning and operational processes for incorporating appropriate resource information into the process of interaction between cities and citizens, and (4) comparison of results with other street-tree management programs of other cities.

INTERPRETING THE URBAN ENVIRONMENT (3.13)

MONTCRIEF, Lewis and STYNES, Daniel J.
Michigan State University
Department of Park and Recreation Resources
East Lansing, Michigan 48824

(517) 355-0823

Sponsored by: USDA Forest Service, North Central Forest Experiment Station, Chicago, Illinois

Completion date: April 1, 1980

1. Review the state of the art of interpretive research and assess its relevance and applicability to urban environmental themes and urban audiences.

2. Complete a detailed inventory of existing interpretive facilities in southeastern states.

3. Select one or more areas and conduct a detailed comprehensive evaluation of interpretive programs and facilities in terms of their applicability to the needs of urban society.

URBAN FOREST DEVELOPMENT (3.32)

MCBRIDE, Joe R. and JACOBS, D.
Department of Forestry
University of California
Berkeley, California 94720

(415) 642-2482

Sponsored by: McIntire-Stennis Cooperative Forestry Research Program

Starting and completion dates: 1975-1979

This project seeks to understand the transition from wildland forest to urban forest in the western United States. Where cities have developed, variables of wildland forests are believed to influence the character of the urban forest and fate of relict trees following development. Cities in contrasting forest types are being studied; wildland forest species composition, tree density, size distribution, crown cover, and age structure are measured and compared with the same variables in the developed urban forests.

Citations of publications produced from this project:

McBride, J. and D. Jacobs. 1976. Urban forest development: a case study, Menlo Park, California. Urban Ecol. 2(1):1-4.

McBride, J. and D. Jacobs. 1979. Urban forest structure: a key to urban forest planning. Calif. Agric. 36(5):24-25.

MINIMUM-MAINTENANCE VEGETATION SYSTEMS FOR EXTENSIVE-USE URBAN PARKLANDS (3.32)

RICHARDS, Norman A.
SUNY College of Environmental Science and Forestry
Syracuse, New York 13210

(315) 473-8656

Since 1974, ecologically sophisticated but low-labor techniques of vegetation management have been initiated in selected low-use, high productivity city parks in Syracuse, New York. The techniques are monitored for their ecological (biotic) and social implications.

DEVELOPING A NATURAL RESOURCE INVENTORY PROCEDURE FOR AN URBAN-EDGE TOWN: POMPEY, NEW YORK (3.32/3.34)

RICHARDS, N. A. and TESSIER, J. D.
SUNY College of Environmental Science and Forestry
Syracuse, New York 13210

(315) 473-8656

3.32 Land-Use Planning

Starting and completion dates: 1978-1979

Develops and evaluates methodology for use by a Town Environmental Commission (Pompey, NY) for inventorying forest and farmland resources. The methodology is applicable to an urban-edge town, and gives special attention to distinguishing between cover conditions, resource uses, and resource values.

URBAN LAND-USE CHANGE: PLANNING OPTIONS FOR URBAN FORESTRY MANAGEMENT (3.32)

SANDERS, Ralph A. and ROWNTREE, Rowan A.
Maxwell School
Syracuse University
Syracuse, New York 13210

(315) 473-8673

Sponsored by: USDA Forest Service, Northeastern Forest Experiment Station, SUNY College of Environmental Science and Forestry, Syracuse, New York 13210

Starting and completion dates: October 15, 1978-May 15, 1979

1. Evaluate existing research on urban land-use change and the effects of urban land use on the distribution and function of the urban forest.

2. Evaluate the distribution of, and demand for, selected land uses in older American cities. A first stage objective will focus on the creation of vacant land in the urban residential core. Particular attention will be given to cities having a large quantity of vacant land or a significant number of obsolete or near-obsolete structures, or cities having a significant proportion of their housing constructed before 1945. This objective deals with, but is not limited to, the identification of sites for possible urban afforestation.

3. Construct a model of recent and future urban land-use change that incorporates the economic, social, and political variables necessary to understand this phenomenon. This includes the consideration of urban land values, demand for various categories of land uses and locations, the demand for certain residential locations, property taxes, public intervention in the land market, and the increasing cost of energy as it affects the distribution of land uses through its effects on transportation and the economic viability of existing buildings.

CONCEPTS AND METHODS OF FOREST RESOURCE PLANNING AND MANAGEMENT AT THE METROPOLITAN FRINGE (3.32/3.34)

STRONG, Ann Louise, COUGHLIN, Robert E. and ROWNTREE, Rowan A.

Department of City and Regional Planning
University of Pennsylvania
Philadelphia, PA 19101

(215) 243-8329

Sponsored by: The USDA Forest Service, Northeastern Forest Experiment Station, SUNY College of Environmental Science and Forestry, Syracuse, New York 13210

Starting and completion dates: January 1979-December 1979

The first phase of this multidisciplinary study is designed to develop the appropriate concepts and methods for mid- and long-term management of the forest and vegetation resources in suburbanizing counties. The second phase (June 1980-June 1981) will test these concepts and methods through the application of a management plan for a portion of the Brandywine Valley near Philadelphia, Pennsylvania. First phase work is divided into the following tasks: (1) developing concepts and methods for defining, measuring, and evaluating the forest and vegetation resource; (2) simulating future population and economic changes in the Philadelphia-Wilmington metropolitan region through the year 2000; (3) translating these changes into planning variables at the county scale; and (4) developing alternative forest and vegetation management strategies in the context of probable future land-use patterns (county scale). These management strategies incorporate an understanding of the distribution of benefits and costs over time and among public and private sectors. Management objectives include: surface and ground water quality and quantity, air quality, microclimate, acoustics, wildlife, aesthetics and recreation, and timber utilization.

MANAGEMENT AND PLANTING OF TREES IN URBAN SITUATIONS (3.34)

PERRY, Thomas
North Carolina Agricultural Experiment Station
North Carolina State University
Raleigh, North Carolina 27067

(919) 737-2891

Sponsored by: USDA Forest Service, Athens, GA

3.32 Land-Use Planning

Starting and completion dates: September 1, 1978-August 31, 1980

Describe successful and unsuccessful urban tree programs in U.S. cities. Include organization, content, legal setting, establishment, and maintenance in the southern states. Also, arrange for long-term, cooperative study with permanent plots in municipal areas, as desired by municipal and state foresters.

Rowntree, Rowan A., and Judith L. Wolfe, compilers.
1980. Abstracts of urban forestry research in progress--1979. Northeast. For. Exp. Stn., Broomall, Pa.
72 p. (USDA For. Serv. Gen. Tech. Rep. NE-60)

Summary of research in progress on urban forestry. Abstracts inform researchers of ongoing work and help urban forest managers anticipate results of interest to them.

273(048.1)

Keywords: urban forestry

Headquarters of the Northeastern Forest Experiment Station are in Broomall, Pa. Field laboratories and research units are maintained at:

- Amherst, Massachusetts, in cooperation with the University of Massachusetts.
- Beltsville, Maryland.
- Berea, Kentucky, in cooperation with Berea College.
- Burlington, Vermont, in cooperation with the University of Vermont.
- Delaware, Ohio.
- Durham, New Hampshire, in cooperation with the University of New Hampshire.
- Hamden, Connecticut, in cooperation with Yale University.
- Kingston, Pennsylvania.
- Morgantown, West Virginia, in cooperation with West Virginia University, Morgantown.
- Orono, Maine, in cooperation with the University of Maine, Orono.
- Parsons, West Virginia.
- Princeton, West Virginia.
- Syracuse, New York, in cooperation with the State University of New York College of Environmental Sciences and Forestry at Syracuse University, Syracuse.
- University Park, Pennsylvania, in cooperation with the Pennsylvania State University.
- Warren, Pennsylvania.

Clemson University
3 1604 003 838 390

DATE DUE

JUN 1 1 1992
Ret'd MAY 0 1 1992
NOV 2 3 1992
Ret'd NOV 2 3 1992

DEMCO, INC. 38-2931